

# **Asymmetric Information between the Taxpayer and the Tax Authority – Income Shifting via Patents**

Harald J. Amberger  
Dartmouth College  
WU Vienna University of Economics and Business  
[harald.amberger@tuck.dartmouth.edu](mailto:harald.amberger@tuck.dartmouth.edu)

Benjamin Osswald  
University of Wisconsin – Madison  
[osswald2@wisc.edu](mailto:osswald2@wisc.edu)

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## **Abstract**

We examine the association between asymmetric information and tax-motivated income shifting via patents in a setting of incomplete information. As the value of patents is often firm-specific, the local tax authority lacks information on comparable transactions when assessing a multinational corporation's (MNC's) transfer-pricing strategies, leading to information asymmetry between the MNC and the local tax authority. Using a sample of affiliates of European MNCs and employing the relative share of patents held by an MNC as a measure for asymmetric information, we show that tax-motivated income shifting increases in information asymmetry. We also find that more external comparable information available to the local tax authority and stricter tax enforcement mitigate this relation. In contrast, more extensive transfer-pricing documentation requirements are less effective in this setting. Overall, our results suggest that the level of comparable information is an important determinant of tax-motivated income shifting via patents. The effectiveness of tax-policy measures in curbing income shifting critically depends on their ability to increase the set of comparable information.

## 1. Introduction

There is broad agreement in academic research and the public debate that multinational corporations (MNCs) reduce their worldwide tax burden by shifting taxable income across borders and by relocating economic activity to low-tax jurisdictions (see Dharmapala (2014) and Riedel (2018) for reviews of the literature). In this regard, recent policy initiatives, such as the OECD Action Plan on Base Erosion and Profit Shifting (OECD 2015b) and the Platform for Collaboration on Tax (IMF et al. 2017), perceive patents to be the key mechanism for income shifting because their value is hard to determine for tax purposes. While prior research provides evidence for the extent to which MNCs use patents to shift income (Grubert 2003; Griffith, Miller, and O’Connell 2014; Beer and Loeprick 2015), the role of comparable information for the valuation of intra-firm royalty payments has received little attention. In this paper, we study whether and to what extent asymmetric information between an MNC and the local tax authority is associated with tax-motivated income-shifting via patents. In addition, we examine whether tax-policy measures designed to curb tax-motivated income shifting mitigate this relation.

For tax purposes, an MNC is supposed to charge a price for an intra-firm transaction that is comparable to similar transactions between unrelated parties (OECD 2017a). To justify this “arm’s length” transfer price, an MNC could draw on comparable information from its own transactions with unrelated parties or from economically similar transactions (De Simone 2016; IMF et al. 2017). The tax authority, on the other hand, requires external comparable information to benchmark the transfer price determined by the MNC against the price for transactions between unrelated parties (OECD 2017a). Comparable information for intra-firm transactions involving royalty payments for the use of patents is scarce (De Waegenaere, Sansing, and Wielhouwer 2012; De Simone and Sansing 2018). Thus, the “true” economic value of royalty

payments could be difficult to determine and both the MNC and the local tax authority have incomplete information about the precise value of the transaction.<sup>1</sup> However, since the value of patents is often firm specific and the MNC owning the asset possesses specific knowledge about the underlying value drivers, the MNC has a more complete information set than the local tax authority (Blair-Stanek 2015; Gallemore, Huang, and Wentland 2018). As a result, information asymmetry between the parties emerges, making it more difficult for the local tax authority to assess the arm's length price. Thus, asymmetric information could reduce the likelihood that the local tax authority detects and challenges an aggressive tax-position and we expect tax-motivated income shifting to increase in information asymmetry.

Examining this relation is important because tax practices of MNCs that involve patents have gained public attention and the amounts of taxes allegedly avoided are significant. For instance, GlaxoSmithKline saved \$3.4 billion in taxes by paying intra-firm royalties to low-tax jurisdictions (Matthews and Whalen 2006). Amazon in Luxembourg, Starbucks in the Netherlands, and Apple in Ireland used similar structures, with the latter resulting in tax savings of \$14 billion (Chee 2019). Further, several countries currently take actions to curb tax-motivated income shifting, for instance, by introducing documentation requirements (Lohse and Riedel 2013) or by tightening tax enforcement (De Simone, Stomberg, and Williams 2019). The design of effective tax-policy measures requires a profound understanding of the factors that enable MNCs to shift income.

While an MNC could hold several forms of intangible assets, we focus on income shifting via patents for three reasons. First, tax-policy initiatives and public tax cases perceive patents to

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<sup>1</sup> A similar economic problem of information asymmetry under incomplete information arises for example also in emissions taxation (Baron 1985) or knowledge transfer in a sender-receiver framework (Lin, Geng, and Whinston 2005).

be the main intangible asset MNCs use to shift income (OECD 2015). The OECD BEPS Action Plan, for instance, identifies royalty payments on patents as a major source of base erosion in high-tax jurisdictions and provides guidance for policy makers to limit this form of income shifting. Second, patents are regularly granted to and held by foreign affiliates of MNCs while tax and legal restrictions imply that other intangible assets, such as trademarks, are more strongly concentrated in the home country of the MNC (Heckemeyer, Olligs, and Overesch 2018). The wider distribution of patents within MNCs provides opportunities to shift income and to exploit country-level differences in corporate income tax rates (Karkinsky and Riedel 2012; Griffith et al. 2014). Third, unlike other forms of intangible assets, such as trade secrets or know-how, patents are publicly disclosed to protect an invention and thus observable in archival datasets.

To examine the relation between information asymmetry and tax-motivated income shifting, we use affiliate-level unconsolidated financial statement data from Bureau van Dijk's Orbis database. We link this data with the Worldwide Patent Statistical Database PATSTAT, providing detailed information on patent owners, applications, grants, and citations. We measure asymmetric information associated with patents through affiliate-level patent concentration. Specifically, for each affiliate, we divide the number of patents held by all affiliates of an MNC by the sum of patents held by other MNCs with affiliates operating in the same country-industry-year.<sup>2</sup> This measure is based on the following intuition: if an MNC holds a large share of patents, comparable information on royalty payments is scarce, which facilitates income shifting *from* a non-patent-holding affiliate *to* a foreign affiliate that holds patents (see Figure 1). We focus on this outbound shifting mechanism because external comparable information is most critical for

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<sup>2</sup> By conditioning on MNCs in the same country-industry-year, we rule out that different patenting strategies across industries affect our measure (Hall, Helmers, Rogers, and Sena 2014).

tax authorities assessing the royalty payments of non-patent holding affiliates (OECD 2015b). We include this measure in a modified version of the income-shifting model developed by Huizinga and Laeven (2008) and recently extended by De Simone, Klassen, and Seidman (2017).

Consistent with our prediction, we find that tax-motivated income shifting increases in the level of asymmetric information. This effect is also economically significant: a one standard deviation increase in patent concentration implies a 25.6 percent higher elasticity of an affiliate's return on assets to income-shifting incentives induced by differences in corporate income tax rates. We also find a higher sensitivity to incremental income-shifting incentives associated with intellectual property (IP) box regimes providing preferential tax rates on IP income. These results hold when calculating patent concentration using patent citations as a proxy for the value of patents, when applying the statutory corporate income tax rate in the affiliate country to capture income-shifting incentives, and when excluding loss affiliates. Thus, our results suggest that the level of asymmetric information between an MNC and the local tax authority over how to value royalty payments is an important determinant of tax-motivated income shifting via patents.

We next explore whether potential alternative sources of information available to the local tax authority mitigate the association documented in our baseline tests. First, local tax authorities could benchmark profit margins of foreign affiliates receiving royalty payments against those of local patent holding affiliates to detect and challenge potentially aggressive transfer-pricing strategies. As expected, we find that more external comparable information in the form of local patent-holding affiliates mitigates the relation found in our baseline tests. This result suggests that more external comparable information dampens tax-motivated income shifting via patents. Further, variation in the effect of information asymmetry conditional on the extent of external comparable information available to the local tax authority supports the argument that our

measure is likely to capture asymmetric information between the MNC and the local tax authority. Second, we examine whether tax-policy measures designed to curb income shifting have a similar effect. For instance, the information set of a local tax authority could increase if the MNC is required to provide more extensive documentation for its transfer-pricing strategies. Exploiting the adoption of transfer-pricing documentation requirements, we find less income shifting on average. However, these rules have only a weak mitigating effect on the association between patent concentration and income shifting since they do not directly increase the set of comparable information. Thus, the effectiveness of transfer-pricing documentation requirements depends on their ability to reduce asymmetric information between an MNC and the local tax authority.

We also explore whether our main findings are due to asymmetric information lowering the likelihood that an aggressive tax-position is detected and successfully challenged by local tax authorities. To test this, we follow De Simone et al. (2019) and examine whether an increase in country-level tax enforcement mitigates our baseline association. We do not find a mitigating effect for an increase in overall tax administration expenditures as a proxy for the *perceived* level of tax enforcement. However, higher values of completed tax assessments and more staff used in tax audits, which suggest an increase in *actual* tax enforcement, mitigate the relation between patent concentration and tax-motivated income shifting. These results indicate that asymmetric information between an MNC and the local tax authority lowers the likelihood of detecting and successfully challenging an aggressive tax-position, shaping the extent to which MNCs shift income via patents.

We conduct additional tests to rule out alternative explanations and to further validate our measure. First, since patent concentration could be correlated with the market share of an

affiliate in the country-industry-year in which it operates, our results could also reflect income shifting associated with market power. After adding interaction terms between market power and variables that capture income-shifting incentives, we continue to find that patent concentration is associated with more income shifting, alleviating concerns that our proxy might capture an affiliate's market power. Second, we examine income shifting via debt as a falsification test since information asymmetry associated with patents should have no effect in this setting. Consistent with this expectation, we find no association between patent concentration and this income-shifting channel. This result provides comfort that our measure captures asymmetric information associated with patents. Third, we examine affiliates that hold patents and document that the level of asymmetric information is also associated with the extent to which an MNC shifts income via patents to a particular patent-holding affiliate.

Our study makes several contributions to the literature. First, we expand research on the determinants of tax-motivated income shifting (Bartelsman and Beetsma 2003; Clausing 2003; Grubert 2003; Markle 2016; De Simone et al. 2017; Blouin, Robinson, and Seidman 2018) by showing that the extent of asymmetric information between an MNC and the local tax authority is an economically important determinant of income shifting via patents. Prior findings by De Simone (2016) indicate that *less* comparable information constrains an MNC's ability to justify aggressive transfer-pricing strategies, which is associated with *less* tax-motivated income shifting. Our results, in contrast, suggest that, because the value of patents is firm-specific, *less* comparable information facilitates income shifting in this setting. More generally, since the level of asymmetric information depends on the distribution of patents within an industry, our results also highlight that industry landscapes shaped by the number of comparable assets or firms determine the extent to which MNCs can shift income.



Second, we contribute to research on the effectiveness of tax-policy measures designed to limit tax-motivated income shifting. While Joshi et al. (2018) and Joshi (2019) find that the mandated disclosure of tax-related information reduces tax-motivated income shifting on average, our results suggest that tax-policy measures that effectively curb income shifting via patents need to be targeted. Specifically, these policy measures have to increase either the set of comparable information or the likelihood that the tax authority might detect and successfully challenge an aggressive tax position. More extensive transfer-pricing documentation requirements that do not directly increase the level of comparable information are unlikely to limit the extent to which MNCs shift income via patents.

Finally, our findings inform studies that examine specific income-shifting channels. While prior studies focus on tax incentives associated with statutory corporate income tax rates (e.g., Grubert 2003; Clausing 2003; Dharmapala and Riedel 2013; Heckemeyer and Overesch 2017; Blouin et al. 2018), our findings imply that researchers need to incorporate the incremental tax incentives induced by IP box regimes in their empirical models to detect income shifting via patents. Tests that exclusively focus on income-shifting incentives associated with differences in statutory corporate income tax rates might be insufficient to achieve this goal.

## **2. Background and Hypothesis Development**

### *2.1 Transfer Pricing and the Arm's Length Standard*

While market forces determine the prices for transactions between unrelated enterprises, an MNC has to value intra-firm transactions for tax purposes by applying a transfer price. The OECD defines a transfer price as “the price at which an enterprise transfers physical goods and intangible property or provides services to associated enterprises” (OECD 2010). According to the OECD guidelines, the applicable transfer price has to follow the “arm’s length standard”

(OECD 2017a). Most countries adopted this principle in domestic tax law and in their double tax treaties (IMF et al. 2017). The principle requires the price charged for an intra-firm transaction (“controlled transaction”) to be comparable to prices charged between unrelated parties for similar transactions entered into under similar economic circumstances (OECD 2017a). The arm’s length standard should constrain tax-motivated income shifting and ensure that the allocation of taxable income across taxing jurisdictions is in line with economic activity and value creation.

The OECD transfer-pricing guidelines provide several methods an MNC may apply to fulfill the arm’s length standard (OECD 2017a).<sup>3</sup> Based on the nature of the transaction, an MNC chooses the most appropriate method, which requires an analysis of the functions, assets, and risks borne by the affiliates involved in the transaction (OECD 2017a). All methods have in common that they require information on comparable uncontrolled transactions to determine key inputs, such as mark-ups or profit margins, for deriving the arm’s length transfer price. The MNC could obtain this information from its own transactions with unrelated enterprises (“internal comparable”) or from transactions between comparable unrelated enterprises (“external comparable”). The latter includes firms operating in the same industry, performing similar functions, and bearing risks similar to the MNC (OECD 2017a). If information on comparable uncontrolled transactions is unavailable, the MNC may determine the arm’s length transfer price by applying different valuation techniques (OECD 2017).

In addition to determining the arm’s length price, an MNC could also use information on comparable uncontrolled transactions to justify the transfer price and to resolve disputes with the local tax authority. De Simone (2016), for instance, examines the introduction of International

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<sup>3</sup> All jurisdictions apply either traditional transaction methods or cost plus methods.

Financial Reporting Standards (IFRS) in several European countries as a setting that increased the set of comparable information. Her results indicate that more comparable information could allow an MNC to substantiate aggressive transfer-pricing strategies and to shift more income.

However, the extent of information available for comparable uncontrolled transactions depends on the nature of the transaction. For tangible goods or services sold on external markets, market or resale prices are readily observable for the MNC and the tax authority (IMF et al. 2017). In contrast, for goods and services without an external market and for assets whose value is firm specific, external information on comparable transactions may not exist or be difficult to obtain (De Waegenaere et al. 2012; De Simone and Sansing 2018). This applies in particular to patents as these assets are often unique to the firm. Further, an MNC owning the patent has greater knowledge about its innovative character and the underlying value drivers (Qiu and Wan 2015; Gallemore et al. 2018). Consequently, patents are considered as hard to value for transfer-pricing purposes, posing a challenge to the arm's length standard and to tax authorities assessing an MNC's transfer-pricing strategies (IMF et al. 2017).

## *2.2 Patents and Tax-Motivated Income Shifting*

The nature of its operations enables an MNC to shift taxable income into low-tax jurisdictions by means of tax-deductible intra-firm interest or royalty payments, and by exploiting discretion in setting transfer prices for these payments.<sup>4</sup> Recent tax-policy initiatives, such as the OECD BEPS Action Plan (OECD 2015) identify cross-border income shifting as the prevalent strategy for MNCs to reduce their worldwide tax burden. Moreover, several studies

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<sup>4</sup> The OECD BEPS Action Plan notes that MNCs exploit discretion in setting transfer prices to deviate from the arm's length standard and to reap tax benefits (OECD 2015). This issue has become increasingly relevant in recent years as countries adopted preferential tax regimes for profits derived from intangibles (see e.g., Evers, Miller, and Spengel 2015; Bornemann, Laplante, and Osswald 2019). These regimes provide substantial tax benefits for profits from royalty payments with tax rates ranging from zero (Malta) to 17 percent (France).

document that reported profits of MNCs are sensitive to tax incentives (e.g., Hines and Rice 1994; Grubert and Mutti 2000; Huizinga and Laeven 2008; Klassen and Laplante 2012; De Simone 2016; Markle 2016).

Action 8 of the OECD BEPS Action Plan posits that royalty payments for the intra-firm use of patents are a major channel for cross-border income shifting (OECD 2015b) and prior research applies different approaches to identify this behavior.<sup>5</sup> One stream of research studies the relation between corporate income tax rates and locational choices for patents. Dischinger and Riedel (2011) and Karkinsky and Riedel (2012) document a negative association between the applicable statutory tax rate and the level of intangible investment as well as the number of patent applications filed in a particular country. Similarly, Griffith et al. (2014) show that MNCs strategically locate valuable patents in countries with preferential tax regimes in order to shift income via royalty payments.

Another stream of research more directly examines an MNC's transfer-pricing strategies and finds that MNCs respond to tax-rate differentials by adjusting intra-firm transfer prices. This result is concentrated in MNCs with high levels of intangible assets and greater organizational complexity (Bartelsman and Beetsma 2003; Clausing 2003). Several studies also show that reported profits are responsive to IP or R&D related tax incentives. Grubert (2003) finds that profits of U.S. MNCs respond to income-shifting incentives and that this effect is stronger for R&D intensive firms. De Simone, Huang, and Krull (2017) find a positive association between foreign profit margins and domestic R&D activity, consistent with MNCs using intangible assets for tax-motivated income shifting. Bornemann, Laplante, and Osswald (2019) exploit the

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<sup>5</sup> Prior literature also documents that MNCs use tax-efficient financial structures as an income-shifting channel (Dharmapala 2014; Riedel 2018; Hopland, Lisowsky, Mardan, and Schindler 2018). In a meta-analysis, Heckemeyer and Overesch (2017), however, identify transfer pricing and licensing as the main drivers of income shifting.

introduction of IP box regimes and find the strongest reduction in effective tax rates for MNCs without income-shifting opportunities.

### 2.3 *Hypothesis Development*

Tax-deductible royalty payments for the use of patents enable MNCs to generate tax savings by shifting income across borders. As outlined above, an MNC has to apply the most appropriate transfer-pricing method and requires information from comparable uncontrolled transactions to determine the arm's length price. Tax authorities, in contrast, require such information to benchmark an MNC's transfer price against comparable uncontrolled transactions and to thereby detect and challenge potentially aggressive income-shifting strategies (De Waegenare et al. 2012; De Simone 2016; De Simone and Sansing 2018).

The type of intra-firm transaction determines the extent of comparable information available to an MNC and the local tax authority and shapes how this information is distributed between the two parties. For intra-firm transactions including tangible goods or standardized services, external comparable information is readily observable (IMF et al. 2017). Therefore, the MNC and the tax authority have similar information sets to determine the arm's length price and to assess the value of an intra-firm transaction.

External comparable information to assess the value of royalty payments for patents, in contrast, is scarce because market prices for these payments are regularly unavailable (Blair-Stanek 2015). Thus, the "true" economic value of these payments is ambiguous and the MNC and the local tax authority have incomplete information about the precise value of the intra-firm transaction.<sup>6</sup> Yet, since the value of patents is often firm-specific and the owner of the patent

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<sup>6</sup> Prior literature documents comparable settings e.g., in emission taxation (Baron 1986). A regulator faces also information asymmetry under incomplete information in determining the economic costs of pollution.

possesses knowledge about the value drivers and the associated profit potential (Qiu and Wan 2015; Gallemore et al. 2018). Consequently, the MNC has a more complete information set than the local tax authority, leading to information asymmetry between the two parties.

The extent of asymmetric information varies with the amount of comparable information available to the local tax authority. If a small number of firms in an industry holds a large share of patents (i.e. patent concentration is high), external comparable information is limited and knowledge about the value drivers is concentrated within a small set of firms. Thus, high patent concentration reduces the set of external benchmarks available to the local tax authority and increases asymmetric information over how to value royalty payments. As the local tax authority lacks appropriate benchmarks to assess the arm's length price, the MNC is able to justify a broader range of potential transfer prices (OECD 2017a; OECD 2015b BEPS Action 8; Mescall and Klassen 2018).

We expect that tax-motivated income shifting increases in the level of information asymmetry. If asymmetric information is high, the MNC has more discretion in setting the arm's length price. Moreover, the MNC is able to substantiate the determined transfer price with information on internal transactions, which is harder to verify for the local tax authority than information on external transactions. Consequently, the level of asymmetric information reduces the likelihood that the local tax authority might be able to detect and successfully challenge an aggressive transfer-pricing strategy, providing an incentive for more tax-motivated income shifting. Based on these arguments, our main hypothesis, stated in the alternative, is as follows:

*H1: Tax-motivated income shifting via patents increases in the level of asymmetric information between the MNC and the local tax authority.*

There are several reasons that we might not find the hypothesized relation. First, several countries adopted transfer-pricing documentation requirements to limit discretion in setting transfer prices and to enforce the arm's length standard (OECD 2017a).<sup>7</sup> Prior research shows that these requirements reduce cross-border income shifting (e.g., Klassen and Laplante 2012; Lohse and Riedel 2014; Beer and Loeprick 2015; Mescall and Klassen 2018). If transfer-pricing documentation requirements increase the information set of the local tax authority by revealing an MNC's information about the value drivers and the profit potential associated with a patent, the likelihood of detecting and challenging aggressive transfer-pricing strategies could increase and we might not find a relation between asymmetric information and tax-motivated income shifting. Second, several countries recently tightened their tax enforcement (OECD 2017a). If these efforts specifically target affiliates of MNCs with high patent concentration, the likelihood that a local tax authority detects and successfully challenge an aggressive transfer-pricing strategy could increase and we might not find an association between information asymmetry and tax-motivated income shifting. Third, recent survey evidence suggests that many MNCs favor compliance with the arm's length standard over tax aggressiveness (Klassen, Lisowsky, and Mescall 2017). Thus, if MNCs seek tax compliance or tax aggressiveness independent from the extent of asymmetric information, we might not find support for our hypothesis.

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<sup>7</sup> Based on guidelines by the OECD, the national frameworks include statutory requirements to provide supporting information for transfer prices set by an MNC that are coupled with substantial penalties for non-compliance. From 1994 to 2019, the number of countries that implemented such requirements increased from five to more than 80. The majority of countries also apply penalties for non-compliance (Lohse and Riedel 2013; Deloitte 2019).

### 3. Research Design, Data, and Sample Selection

#### 3.1 Income-Shifting Model

We base our research design on the income-shifting model developed by Hines and Rice (1994) and expanded by Huizinga and Laeven (2008). These models apply a Cobb-Douglas production function to estimate affiliate-level taxable income prior to income shifting as a function of capital, labor, and productivity. We apply the most recent extension by De Simone, Klassen, et al. (2017) to include unprofitable affiliates.<sup>8</sup> Equation (1) depicts this model.

$$\begin{aligned} \ln(1 + ROA)_{it} = & \alpha_c + \alpha_j + \alpha_t + \beta_1 \ln(TangibleAssets)_{it} + \beta_2 \ln(CompExpense)_{it} + \\ & \beta_3 IndustryROA_{cjt} + \beta_4 \ln(Age)_{it} + \beta_5 GDPGrowth_{ct} + \\ & \beta_6 \Delta MarketSize_{cjt} + \beta_7 C_{it} + \beta_8 Loss_{it} + \beta_9 C * Loss_{it} + \varepsilon_{it} \end{aligned} \quad (1)$$

The dependent variable,  $\ln(1+ROA)$  is the natural logarithm of affiliate  $i$ 's return on assets ( $ROA$ ) in year  $t$ . By adding 1 to  $ROA$  before taking logs, we include affiliates with a negative return on assets in year  $t$ , i.e. unprofitable affiliates (Claessens and Laeven 2004; De Simone et al. 2017). In line with prior research (Huizinga and Laeven 2008; Klassen and Laplante 2012; Markle 2016; De Simone 2016; Blouin et al. 2018), we use book income as a proxy for taxable income and calculate  $ROA$  as earnings before interest and taxes (EBIT) divided by total assets.<sup>9</sup>

We include the logarithm of affiliate tangible fixed assets and affiliate compensation expense as proxies for capital and labor input. To measure productivity, we compute  $IndustryROA$  as the median  $ROA$  by country-industry-year (De Simone et al. 2017). We use all

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<sup>8</sup> We include unprofitable affiliates in our sample because prior literature suggests that current losses affect an MNC's income-shifting behavior via patents. Hopland et al. (2018), for instance, find that royalty payments provide MNCs with flexibility to adjust income-shifting strategies and to exploit tax incentives associated with unprofitable affiliates.

<sup>9</sup> We use EBIT instead of pre-tax income because it is unaffected by intra-firm interest payments (Heckemeyer and Overesch 2017) allowing a cleaner identification of income shifting via patents. We explore income shifting via interest payments in supplemental tests (see Section 5.2).



affiliates and independent firms available by two-digit NACE country-industry-year.  $LN(Age)$  is the natural logarithm of affiliate age, calculated as year  $t$  less the first year affiliate  $i$  appears in the database. Further, we include annual GDP growth in affiliate country  $c$  ( $GDPGrowth$ ) and the annual percentage change in total sales of all affiliates and independent firms by two-digit NACE country-industry-year ( $\Delta MarketSize$ ) to control for profitability shocks at the affiliate country-level and the affiliate industry-level (De Simone et al. 2017).

$C$  is the tax incentive to shift income associated with affiliate  $i$ . Following Huizinga and Laeven (2008), we calculate  $C$  based on the weighted tax-rate differential of affiliate  $i$  relative to all affiliates of the same MNC in year  $t$  to reflect the income-shifting incentive of affiliate  $i$  relative to all other affiliates. Tax-rate differentials are based on statutory corporate income tax rates. As reflected in Equation (2), we weigh tax-rate differentials by total affiliate assets ( $K$ ) to account for the costs of income shifting (Huizinga and Laeven 2008; Markle 2016).

$$C_{it} = \frac{1}{(1-\tau_{it})} * \frac{\sum_{k \neq i}^n \frac{K_{kt}}{(1-\tau_{kt})} * (\tau_{it} - \tau_{kt})}{\sum_{k \neq i}^n \frac{K_{kt}}{(1-\tau_{kt})}} \quad (2)$$

Depending on the relative income-shifting incentive associated with affiliate  $i$ ,  $C$  could take either positive or negative values. A higher (lower) value for  $C$  suggests that affiliate  $i$  is a relatively high-tax (low-tax) affiliate, implying a tax incentive to shift income to (from) affiliates with lower (higher) values of  $C$ . Therefore, a negative coefficient on  $\beta_7$  suggests that taxable income of affiliate  $i$  is sensitive to this income-shifting incentive, consistent with evidence for tax-motivated income shifting. The  $C$  measure varies across affiliates due to country-level differences in statutory corporate income tax rates and differences in the location of affiliates within an MNC. Further, changes in statutory corporate income tax rates lead to variation in  $C$  over time. We follow De Simone, et al. (2017) and include  $Loss$ , which is an indicator variable

with the value of one if EBIT of affiliate  $i$  is less than zero. As income-shifting incentives might differ for unprofitable affiliates, we interact  $C$  with  $Loss$ .

Finally, we include a series of fixed effects. First, we add affiliate country-fixed effects ( $\alpha_c$ ) to control for time invariant country-level differences in tax regimes and institutions. Second, we include affiliate industry-fixed effects ( $\alpha_j$ ) to capture time invariant differences in income-shifting opportunities, productivity, and profitability across industries. Third, we include year-fixed effects ( $\alpha_t$ ) to absorb the effects of business cycles and economic shocks. We cluster standard errors by affiliate to account for serial correlation in the data (Petersen 2009).

### 3.2 Research Design for Testing the Effect of Asymmetric Information

To test our main hypothesis, we estimate the following regression model, extending Equation (1) in two ways:

$$\begin{aligned}
 LN(1 + ROA)_{it} = & \alpha_c + \alpha_j + \alpha_t + \sum Controls + \beta_7 C_{it} + \beta_8 C\_Patents_{it} + \beta_9 Loss_{it} + \\
 & \beta_{10} C * Loss_{it} + \beta_{11} C\_Patents * Loss_{it} + \beta_{12} PatentConc_{it} + \\
 & \beta_{13} C * PatentConc_{it} + \beta_{14} C\_Patents * PatentConc_{it} + \varepsilon_{it}
 \end{aligned} \tag{3}$$

First, we add  $C\_Patents$  and its interaction with  $Loss$  to account for income-shifting incentives not captured by  $C$ . Several countries offer IP box regimes with preferential tax rates for income derived from patents (Evers et al. 2015).<sup>10</sup> To obtain  $C\_Patents$ , we re-calculate  $C$  for affiliate  $i$  using IP tax rates instead of statutory corporate income tax rates. We then subtract  $C$  to capture the incremental income-shifting incentive associated IP tax rates. The interpretation of this measure is consistent with  $C$ : a higher (lower) value for  $C\_Patents$  indicates an incremental

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<sup>10</sup> Although the scope of IP box regimes varies across countries, all IP box regimes offer preferential tax rates on patent income.

incentive to shift income to (from) other affiliates via patents. Thus, a negative coefficient on  $\beta_8$  indicates that taxable income of affiliate  $i$  is sensitive to the incremental shifting incentive, which is again consistent with tax-motivated income shifting.

Second, we include *PatentConc* as a measure for the extent of asymmetric information associated with patents held by an MNC. For affiliate  $i$ , we calculate the number of patents held by all domestic and foreign affiliates of the MNC in year  $t$ . We then divide this number by the sum of patents held by domestic and foreign affiliates of MNCs operating in the same country-industry-year as affiliate  $i$ .<sup>11</sup> As shown in Figure 1, this measure reflects the extent of patent concentration and is intended to capture information asymmetry associated with cross-border royalty payments *from* a non-patent holding affiliate (i.e. affiliate  $i$ ) *to* a foreign patent-holding affiliate. We focus on outbound shifting incentives since external comparable information, and therefore the level of asymmetric information, is most critical for tax authorities assessing royalty payments of non-patent holding affiliates which threaten to erode the tax base of the affiliate country (OECD 2015b).

*PatentConc* is based on the following intuition: if affiliate  $i$  belongs to an MNC that holds a small fraction of patents compared to other MNCs with affiliates operating in the same country-industry-year, the local tax authority has access to a large set of external comparable information. This leads to low information asymmetry over how to value royalty payments of affiliate  $i$  (panel A). In contrast, if affiliate  $i$  belongs to an MNC that holds a large fraction of patents, external comparable information for the local tax authority is scarce, resulting in high information asymmetry over how to value royalty payments of affiliate  $i$  (panel B).

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<sup>11</sup> We provide a numerical example in Appendix B.

By limiting *PatentConc* to affiliates of MNCs operating in the same country-industry-year, we measure the extent of asymmetric information of affiliate *i* relative to its industry peers. This rules out that differences in patenting strategies across industries might affect our measure (Hall et al. 2014).<sup>12</sup> Further, we focus on patents held by affiliates of MNCs because we are interested in asymmetric information associated with the valuation of cross-border royalty payments. Domestic independent firms could also receive royalty payments if they externally license their patents. Yet, these firms might substantially differ from affiliates of MNCs in terms of functions performed or risk borne, and it is therefore questionable whether they serve as an appropriate benchmark for the local tax authority when assessing the arm's length price of cross-border royalty payments. Indeed, the degree of internationalization is a key criterion for tax authorities in identifying a set of comparable firms (OECD 2015; IMF et al. 2017, p. 29).<sup>13</sup>

INSERT FIGURE 1 HERE

To test our baseline hypothesis and to examine whether patent concentration is associated with tax-motivated income shifting, we interact *PatentConc* with *C* and *C\_Patents*. If MNCs exploit asymmetric information to shift income via patents, we expect  $\beta_{13}$  and  $\beta_{14}$  to be negative. That is, the extent to which the reported profit of affiliate *i* is sensitive to income-shifting incentives should increase in the level of patent concentration. As *PatentConc* is greater than zero only for affiliates of MNCs that hold patents,  $\beta_{13}$  and  $\beta_{14}$  additionally provide indirect evidence for tax-motivated income shifting via patents.

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<sup>12</sup> An alternative measure could use the fraction of patents in a specific patent class rather than industry-affiliation of the MNC. However, informal discussions with practitioners indicate that tax authorities audit MNCs based on their industry-affiliation.

<sup>13</sup> Nonetheless, our main inferences are unchanged when including independent firms operating in the same country-industry-year as affiliate *i* in the calculation of *PatentConc*.

### 3.3 Data and Sample Selection

We construct our sample by merging two distinct data sources. First, we obtain unconsolidated financial statement and ownership data for affiliates of MNCs from Bureau van Dijk's Orbis database, covering the sample period 2008 to 2016. Second, we obtain patent data from the Worldwide Patent Statistical Database PATSTAT.<sup>14</sup> PATSTAT is maintained by the European Patent Office (EPO) and it offers rich bibliographic patent data from more than 100 patent offices worldwide.<sup>15</sup> The available data includes information on patent owners, patent applications, patent grants, and patent citations. We apply Bureau van Dijk's reverse search algorithm, taking into account the affiliate's name and its country of residence, to merge PATSTAT with Orbis. This procedure links patent ownership from PATSTAT to the affiliates recorded in Orbis and provides insights into the locations of patent holdings within MNCs.

Table 1 outlines our sample selection. We identify MNCs with affiliates in at least two different countries and require direct and indirect ownership links within the MNC to be greater than 50 percent.<sup>16</sup> Due to data limitations and to be consistent with prior research (e.g., De Simone 2016; De Simone et al. 2017), we require the parent of the MNC and the foreign affiliates to be located in a European country.<sup>17</sup> We also require non-missing NACE industry codes and positive values for total assets, tangible fixed assets, and compensation expense. These

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<sup>14</sup> We use the "Autumn 2017" edition of PATSTAT.

<sup>15</sup> The database covers patent applications and grants with patent offices in member states of the European Patent Convention (EPC) and other major patent offices, such as the United States Patent and Trademark Office (USPTO). For more information, see <https://www.epo.org/searching-for-patents/business/patstat.html#tab-1>.

<sup>16</sup> One limitation of Orbis is that ownership information is stale and reflects the status of the last year in the dataset. This could lead to measurement error as we might classify an affiliate of a firm that became an MNC towards the end of the sample period as being an affiliate of an MNC throughout. Because income shifting requires a cross-border context, such ownership changes would bias against finding results. As a result, the effect sizes obtained from our regression models are likely to constitute lower bound estimates.

<sup>17</sup> Specifically, we limit our sample to affiliates located in the 28 member states of the European Union and in the four member states of the European Free Trade Association (EFTA). The latter includes Switzerland, Liechtenstein, Norway, and Iceland. We relax this requirement when calculating the income-shifting incentive. That is, we take non-European affiliates with data on total assets into account when calculating  $C$  and  $C\_Patents$  for affiliate  $i$ .

requirements yield an initial sample of 163,865 affiliate-year observations that represent 28,733 affiliates, belonging to 9,088 MNCs.

As outlined in Table 1, we exclude affiliates of MNCs active in the banking or in the insurance industry because of distinct income-shifting incentives in these sectors (Merz and Overesch 2016). We follow De Simone et al. (2017) and require MNCs to be profitable as a group since consolidated losses could alter income-shifting incentives.<sup>18</sup> We further exclude observations with missing values for EBIT and with values for  $LN(1+ROA)$  less than or equal to zero. Finally, we drop observations with insufficient data to calculate regression variables. Our sample covers 138,293 affiliate-year observations, representing 26,608 unique affiliates and 8,489 unique MNCs. On average, we observe 5.2 observations per affiliate and the average MNC has 3.1 foreign affiliates.

INSERT TABLE 1 HERE

### 3.4 Descriptive Statistics

Table 2 presents the sample composition by country.<sup>19</sup> We observe the largest number of affiliate-years for France, Italy, and Spain while the number is lowest for Ireland, Iceland, and Switzerland. In columns 2 and 3, we show information on corporate income tax rates and IP tax rates, respectively. Average corporate income tax rates vary across countries, ranging from 10 percent in Bulgaria to 35 percent in Malta. Similarly, average IP tax rates range from 6 percent in Luxembourg to 30 percent in Germany. For 12 countries in our sample, the average IP tax rate deviates from the average corporate income tax rate. A deviation between two and 27 percentage

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<sup>18</sup> In line with De Simone et al. (2017), we calculate the consolidated return on sales using data for the affiliates in our sample. We drop MNCs with a negative return on sales in year  $t$

<sup>19</sup> Due to our sample selection criteria, our final sample includes affiliates located in 27 countries.

points suggests that  $C$  based on corporate income tax rates does not fully capture the income-shifting incentive associated with patents.

INSERT TABLE 2 HERE

Table 3 presents descriptive statistics. We winsorize continuous variables at the 1<sup>st</sup> and the 99<sup>th</sup> percentile to reduce the influence of outliers in the regression analyses. Panel A shows information for the full sample. The average affiliate reports earnings before interest and taxes of EUR 3.1 million (*EBIT*), a return on assets of 7.5 percent (*ROA*), tangible fixed assets of EUR 7 million, and a compensation expense of 5.9 million. 17.1 percent of the affiliate-years exhibit a negative EBIT (*Loss*). The average affiliate holds 2.8 patents (*PatStock*) and belongs to an MNC owning 35.6 patents (*SumPatents*).<sup>20</sup> Panels B and C present descriptive statistics for patent-holding and non-patent-holding affiliates, respectively. 10.4 percent of the observations in our sample concern patent-holding affiliates (Panel B), which suggests that, within MNCs, patent holdings are concentrated in a relatively small number of affiliates. Patent-holding affiliates exhibit higher EBIT and higher compensation expense. They are also larger than non-patent-holding affiliates (all  $p < 0.01$ ; two-tailed). Both groups do not differ in their return on assets ( $p = 0.79$ ; two-tailed). On average, these affiliates hold 27.3 patents with a standard deviation of 121.3, consistent with few affiliates holding a relatively large number of patents.

INSERT TABLE 3 HERE

Table 4 reports Pearson correlation coefficients. Correlations between our regression variables are generally consistent with prior research using unconsolidated financial statement data for European affiliates (e.g., Huizinga and Laeven 2008; De Simone et al. 2017). Further,  $C$

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<sup>20</sup> *PatStock* is the number of granted patents held by affiliate  $i$  in year  $t$ . This includes all patents granted in the last 19 years because patents normally protect intellectual property for 20 years.

and *C\_Patents* are weakly correlated ( $\rho = 0.13$ ), providing comfort that both measures capture distinct income-shifting incentives.

INSERT TABLE 4 HERE

## 4. Results

### 4.1 Extension of the De Simone et al. (2017) Income-Shifting Model

Before testing our main hypothesis, we extend the income-shifting model by De Simone et al. (2017) and include the incremental income-shifting incentive associated with IP boxes (*C\_Patents*). We report results in Table 5. In column 1, we first estimate Equation (1) on our sample and find results consistent with De Simone et al. (2017). Estimated coefficients exhibit the identical sign and are comparable in magnitude. Most importantly, the coefficient on *C* is negative and significant ( $p < 0.01$ ), consistent with evidence for tax-motivated income shifting. Further, the estimated coefficients on *C* (-0.097) and *C\*Loss* (0.289) are similar to the estimates amounting to -0.088 and 0.251 in De Simone et al. (2017).<sup>21</sup>

In columns 2 and 3, we include *C\_Patents* and the interaction of *C\_Patents* with *Loss*, respectively. While results for the initial variables are consistent with column 1, coefficients on *C\_Patents* and *C\_Patents\*Loss* are insignificant in both columns (all  $p > 0.17$ ). Thus, including *C\_Patents* does not alter the general inferences drawn from the De Simone et al. (2017) model. These results also suggest that, on average, taxable income of the affiliates in our sample is not sensitive to the incremental income-shifting incentive induced by IP boxes.

INSERT TABLE 5 HERE

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<sup>21</sup> The coefficients on *C* and *C\*Loss* translate into a semi-elasticity at the mean *ROA* of -0.97 for profitable affiliates and +1.79 for unprofitable affiliates. These elasticities are slightly larger than estimates in De Simone et al. (2017).



#### 4.2 Baseline Results: Asymmetric Information and Tax-Motivated Income Shifting via Patents

We next test our baseline hypothesis and examine the relation between asymmetric information and income shifting via patents. We limit the sample to non-patent-holding affiliates since MNCs may use royalty payments to shift taxable income *from* non-patent-holding affiliates *to* their patent-holding counterparts. As noted above, external comparable information is most critical for local tax authorities assessing cross-border royalty payments of non-patent holding affiliates (OECD 2015b).

Table 6 presents results of estimating Equation (3). In column 1, we again find a negative and significant coefficient on  $C$  ( $p < 0.01$ ) while the coefficient on  $C\_Patents$  is insignificant ( $p = 0.83$ ). Consistent with H1, coefficients on  $C*PatentConc$  and  $C\_Patents*PatentConc$  are both negative and significant ( $p < 0.04$ ). Thus, tax-motivated income shifting via patents increases with patent concentration. In column 2, we replace the continuous measure for patent concentration with an indicator variable taking the value of one for affiliates with patent concentration in the top sample quartile ( $HighPatentConc$ ). The negative and significant coefficients on  $C*HighPatentConc$  and  $C\_Patents*HighPatentConc$  ( $p < 0.08$ ) again indicate more tax-motivated income shifting via patents for affiliates with high patent concentration.

In economic terms, the coefficient estimates on  $C$  and  $C*PatentConc$  in column 1 imply a semi elasticity of -1.33; i.e. a one percent increase in  $C$  reduces the return on assets of the average affiliate in our sample by 1.33 percent.<sup>22</sup> In this regard, a one standard deviation increase in  $PatentConc$  (0.162) leads to a semi elasticity of -1.67, implying a 25.6 percent change ( $[-1.67 /$

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<sup>22</sup> We calculate the semi-elasticity following De Simone et al. (2017), assuming a one percent change in  $C$ :  $(\exp[(\text{coefficient on } C + \text{coefficient on } C*PatentConc * \text{Mean } PatentConc) * \Delta C + \text{LN}(\text{mean } ROA + 1))] - 1 - \text{mean } ROA) / \text{mean } ROA$ ;  $(\exp[(-0.087 + -0.144 * 0.042) * 0.01 + \text{LN}(0.075 + 1)] - 1 - 0.075) / 0.075 = -1.33$ . This result falls in the range of estimates provided by prior studies (see e.g., Dharmapala (2014) and Riedel (2018)).

-1.33] – 1) in the sensitivity of the average affiliate’s return on assets to the income-shifting incentive captured by *C*. For the incremental income-shifting incentive induced by IP boxes, a one standard deviation increase in *PatentConc* changes the semi elasticity from -0.01 to -0.16.

INSERT TABLE 6 HERE

Taken together, the results in this section support our baseline hypothesis: tax-motivated income shifting increases with patent concentration. Thus, the level of information asymmetry between an MNC and the local tax authority over how to value royalty payments for transfer-pricing purposes significantly facilitates tax-motivated income shifting via patents.

#### 4.3 *The Moderating Effect of External Comparable Information*

Our baseline results suggest that asymmetric information over how to value royalty payments is a determinant of tax-motivated income shifting. In this section, we study whether other sources of information available to the local tax authority mitigate this association to support the argument that *PatentConc* captures asymmetric information associated with patents. Specifically, we test whether more external comparable information in the form of local patent-holding affiliates mitigates the association between patent concentration and tax-motivated income shifting. Figure 2 illustrates our approach.

As discussed in Section 2.1, when assessing an MNC’s transfer-pricing strategy, the local tax authority benchmarks the determined transfer price against comparable information from firms performing similar functions and bearing similar risks (De Simone 2016; OECD 2017a). Rather than benchmarking cross-border royalty payments, the local tax authority could compare the profit margins of foreign patent-holding affiliates to those of local patent-holding affiliates of other MNCs (OECD 2015; IMF et al. 2017). This could increase the likelihood of detecting and

successfully challenging an aggressive transfer-pricing strategy, diminishing the extent to which patent concentration is associated with tax-motivated income shifting.

INSERT FIGURE 2 HERE

To test this conjecture, we define *HighPatAffiliates* as an indicator variable with the value of one if the share of patent-holding affiliates relative to all affiliates of MNCs operating in the country-industry-year of affiliate *i* is in the top quartile.<sup>23</sup> In Equation (3), we then interact *HighPatAffiliate* with *C*, *C\_Patents*, *PatentConc*, and their respective interactions.

We present results in Table 7. For the continuous patent-concentration measure (column 1), coefficients on *C\*PatentConc* and *C\_Patents\*PatentConc* ( $p < 0.03$ ) are again negative and significant. Coefficients on the triple interactions *C\*PatentConc\*HighPatAffiliates* and *C\_Patents\*PatentConc\*HighPatAffiliates* are positive but insignificant ( $p > 0.25$ ). However, for affiliates subject to high asymmetric information (column 2), the coefficients on both triple interactions are positive and significant ( $p < 0.04$ ). These results suggest that more external comparable information in the form of local patent-holding affiliates mitigates the association between patent concentration and tax-motivated income shifting, in particular for affiliates subject to high asymmetric information. Further, since the effect of *PatentConc* varies with the extent of external comparable information available to the local tax authority, these results also suggest that our measure is likely to capture asymmetric information associated with patents.

INSERT TABLE 7 HERE

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<sup>23</sup> Instead of only using the affiliates included in our primary sample, we calculate *HighPatAffiliates* based on *all* affiliates of MNCs available in the Orbis database. This alleviates concerns that differences in data availability across countries or industries might affect our inferences.

#### 4.4 *The Adoption of Transfer-Pricing Documentation Requirements*

The results in the previous section indicate that more external comparable information mitigates the relation between patent concentration and the extent to which MNCs shift income via patents. In this section, we examine whether tax-policy measures designed to curb tax-motivated income shifting could achieve a similar effect. Specifically, we exploit the adoption of transfer-pricing documentation requirements, which prior research has shown to limit tax-motivated income shifting (Lohse and Riedel 2013; Beer and Loeprick 2015). These rules require MNCs to provide the local tax authority with supporting documentation on the arm's length transfer price and the underlying transactions. However, transfer-pricing documentation requirements are not directly designed to increase external comparable information and therefore may not be effective in mitigating the impact of asymmetric information.

We collect country-level information on transfer-pricing documentation requirements from Lohse and Riedel (2013) and Beer and Loeprick (2015) and supplement this data with more recent information from EY Worldwide Transfer Pricing Guides. To isolate the effect of the adoption of transfer-pricing documentation requirements on tax-motivated income shifting, we create *TPDocu*, which is an indicator variable with the value of one if country  $c$  introduced a transfer-pricing documentation requirement in year  $t$  or  $t-1$ , and zero if the country did not alter its rules in these years, and include this variable in Equation (3).<sup>24</sup> *TPDocu* is based on a two-year window because Beer and Loeprick (2015) show that transfer-pricing documentation requirements become fully effective in the first two years after their adoption. We then interact *TPDocu* with  $C$ ,  $C\_Patents$ , *PatentConc* and their respective interactions. This research design

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<sup>24</sup> In our sample, 12 countries had documentation requirements in place for all sample years, 10 countries introduced documentation requirements, and 5 countries did not require any TP-related documentation.

compares the relation between patent concentration and tax-motivated income shifting in the two years after the adoption of transfer-pricing documentation requirements to all affiliate-years where documentation requirements remain unchanged.

We present results in Table 8. In column 1, we first interact *TPDocu* with *C* and *C\_Patents* to examine the unconditional effect of *TPDocu* on tax-motivated income shifting. As expected, we find a positive and significant coefficient on *C\*TPDocu* ( $p = 0.08$ ). The coefficient on *C\_Patents\*TPDocu* is positive but insignificant ( $p = 0.58$ ). Consistent with prior research (Lohse and Riedel 2013; Beer and Loeprick 2015), these results suggest that transfer-pricing documentation requirements are associated with less tax-motivated income shifting on average.

In column 2, we test whether the adoption of transfer-pricing documentation requirements mitigates the relation between patent concentration and tax-motivated income shifting. To this end, we interact *TPDocu* with *C\*PatentConc* and *C\_Patents\*PatentConc*, respectively. The negative and significant coefficients on *C\*PatentConc* and *C\_Patents\*PatentConc* (all  $p < 0.04$ ) again suggest that tax-motivated income shifting increases in patent concentration. However, while we find a positive and significant coefficient on *C\*PatentConc\*TPDocu* ( $p = 0.05$ ), the coefficient on *C\_Patents\*PatentConc\*TPDocu* is insignificant ( $p = 0.62$ ). For affiliates subject to high information asymmetry (column 3), coefficients on *C\*HighPatentConc\*TPDocu* and *C\_Patents\*HighPatentConc\*TPDocu* are both insignificant ( $p > 0.14$ ). These results indicate that, although the adoption of transfer-pricing documentation requirements is associated with less income shifting on average, these measures have only a weak mitigating effect on the relation between patent concentration and tax-motivated income shifting.

Taken together, the results in the last two sections suggest that while more external comparable information dampens tax-motivated income shifting via patents, requiring MNCs to

provide supporting documentation for their transfer-pricing strategies without directly increasing external comparable information is not an effective tax-policy tool in this regard.

INSERT TABLE 8 HERE

#### 4.5 *The Moderating Effect of Stronger Tax Enforcement*

Our baseline hypothesis is based on the argument that asymmetric information over how to value royalty payments lowers the likelihood that local tax authorities might detect and successfully challenge an aggressive transfer-pricing strategy, which facilitates tax-motivated income shifting via patents. If this is the theoretical mechanism underlying our results, we should expect an increase in the likelihood of detecting and challenging an MNC's tax-positions to mitigate the association documented in our main tests.

To examine this conjecture, we follow De Simone et al. (2019) and exploit increases in the level of tax enforcement in the affiliate country. Stronger tax enforcement is expected to raise the likelihood of detection and to reduce the extent to which patent concentration facilitates tax-motivated income shifting via patents. In line with De Simone et al. (2019), we collect data on tax enforcement from OECD's tax-administration surveys (OECD 2011; OECD 2013; OECD 2015a; OECD 2017b). We then construct *Enforcement* as an indicator variable with the value of one if country  $c$  increased tax enforcement in the previous year, and zero otherwise.

We measure tax enforcement in three ways: i) the value of completed tax assessments over total net revenue collections, ii) the percentage of staff used for tax audit and verification, and iii) the total tax administration expenditure over GDP (OECD 2011; OECD 2013; OECD 2015a; OECD 2017b). The first two proxies capture the efficiency and the effectiveness of tax enforcement in country  $c$  while the third proxy measures resources employed in the enforcement

process. Thus, an increase in the value of completed tax assessments and the percentage of staff used for tax audit and verification might indicate a higher level of *actual* tax enforcement. An increase in tax administration expenditure, in contrast, raises the *perceived* level of tax enforcement (Slemrod 2016; De Simone et al. 2019). We again include *Enforcement* in Equation (3) and interact this variable with *C*, *C\_Patents*, *PatentConc* and their respective interactions.

We present results in Table 9.<sup>25</sup> In the first two columns, we measure *Enforcement* through the value of completed tax assessments. In column 1, we again find that patent concentration is associated with more tax-motivated income shifting. The positive and significant coefficients on the triple interactions *C\*PatentConc\*Enforcement* and *C\_Patents\*PatentConc\*Enforcement* ( $p < 0.04$ ) indicate that an increase in actual tax enforcement mitigates this relation. In column 2, we find similar results for affiliates subject to high information asymmetry. In columns 3 and 4, we measure *Enforcement* through staff used in tax audit and verification. The positive and significant coefficient on *C\_Patents\*HighPatentConc\*Enforcement* (column 4;  $p = 0.03$ ) supports the results in columns 1 and 2. In columns 5 and 6, we use total tax administration expenditure to measure *Enforcement*. While we again find that tax-motivated income shifting is increasing in patent concentration, a higher level of perceived tax enforcement does not alter this relation. Overall, these results suggest that stronger *actual* tax enforcement reduces the extent to which asymmetric information is associated with tax-motivated income shifting. These tests also indicate that our baseline results are due to asymmetric information lowering the likelihood that the local tax authority might detect and challenge an aggressive tax-position.

INSERT TABLE 9 HERE

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<sup>25</sup> In Table 9, the loss in sample size is due to the OECD enforcement data being unavailable for all sample years. Moreover, data availability varies across our three proxies, leading to different sample sizes for each test.

## 5. Robustness Tests and Supplementary Analyses

### 5.1 Robustness Tests

To assess the robustness of our baseline findings, we conduct several tests and report results in Table 10. First, we modify our measure for patent concentration, which assumes that asymmetric information increases in the relative number of patents held by an MNC. Aside from the number of patents, asymmetric information could also increase in the relative value of the patents held by an MNC. To test this, we follow Hall, Jaffe, and Trajtenberg (2005) and recalculate our measure using the number of patent citations as a proxy for patent value (*PatentQualityConc*). Consistent with our baseline results, coefficients on  $C*PatentQualityConc$  and  $C\_Patents*PatentQualityConc$  (all  $p < 0.03$ ) are negative and significant (column 1).

Second, we use the corporate income tax rate in country  $c$  as a measure for income-shifting incentives. While  $C$  captures the incentive to shift income associated with affiliate  $i$  relative to *all* other affiliates belonging the same MNC, weighting tax-rate differentials by total assets raises concerns that changes in an affiliate's asset base could impact our main results. Therefore, we replace  $C$  with the corporate income tax rate in country  $c$  ( $CTR$ ).<sup>26</sup> Consistent with tax-motivated income shifting, we expect the taxable income of affiliate  $i$  to decrease in the statutory tax rate. Results in column 2 support this expectation. Coefficients on  $CTR$  and  $CTR*PatentConc$  are both negative and significant ( $p < 0.01$ ). Thus, patent concentration is associated with less (more)

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<sup>26</sup> We do not include the IP tax rate since non-patent-holding affiliates are unlikely to report taxable income subject to this rate. When adding the difference between the IP tax rate and the corporate income tax rate ( $CTR\_Patents$ ) to capture incremental income-shifting incentives associated with IP boxes, we find insignificant coefficients on  $CTR\_Patents$  and  $CTR\_Patents*PatentConc$  (untabulated; all  $p > 0.36$ ). For patent-holding affiliates, however,  $CTR\_Patents*PatentConc$  is negative and significant ( $p = 0.07$ ), consistent with these affiliates reporting income subject to this rate in particular when information asymmetry is high.



income reported in high-tax (low-tax) affiliates. Corroborating our main findings, these results suggest that changes in an affiliate's asset base are unlikely to drive our main results.

Third, we modify our dependent variable and assess the sample selection underlying our empirical approach. We replace  $LN(1+ROA)$  with the natural logarithm of earnings before interest ( $LN(EBIT)$ ) and pre-tax income ( $LN(PLBT)$ ), respectively. This approach is consistent with the income-shifting model in Huizinga and Laeven (2008) and has been widely used by prior research (e.g., De Simone 2016; Markle 2016; Blouin et al. 2018). Since the natural logarithm is undefined for negative values, loss observations are excluded from the sample. When using  $LN(EBIT)$  as a dependent variable, we find a negative and significant coefficient on  $C*PatentConc$  ( $p < 0.01$ ) in column 3 while the negative coefficient on  $C\_Patents*PatentConc$  is marginally insignificant ( $p = 0.14$ ). For  $LN(PLBT)$ , both coefficients are negative and significant (column 4;  $p < 0.02$ ). These results suggest that our findings are robust to different specifications of the income-shifting model and to excluding loss affiliates from the sample.

INSERT TABLE 10 HERE

## 5.2 Controlling for the Effect of Market Power on Tax-Motivated Income Shifting

One concern with *PatentConc* is that our measure could be correlated with market power, i.e. affiliates of MNCs holding a large share of patents could also have high power in their local markets. Similar to asymmetric information associated with patents, the local tax authority might lack external comparable information if an MNC controls a significant share of the local market. Thus, instead of capturing the effect of asymmetric information, our results could be driven by income shifting associated with market power. To control for market power, we calculate *MarketShare* as total sales of affiliate  $i$  in year  $t$  divided by total sales of all firms in the same

country-industry-year.<sup>27</sup> By including all firms in a country-industry-year, we measure the share of the local market controlled by affiliate  $i$ . We then interact *MarketShare* with  $C$  and  $C\_Patents$ , respectively, and re-estimate Equation (3) for the full sample.

We present results in Table 11.<sup>28</sup> Consistent with our main results (Table 6, column 1), the coefficients on  $C*PatentConc$  and  $C\_Patents*PatentConc$  are negative and significant ( $p < 0.07$ ) and their magnitudes are comparable to our baseline estimates (column 1). The coefficients on  $C*MarketShare$  and  $C\_Patents*MarketShare$  are negative but insignificant ( $p > 0.13$ ). In column 2, we obtain generally consistent results. The coefficient on  $C*HighPatentConc$  is negative and significant ( $p = 0.04$ ) while the negative coefficient on  $C\_Patents*HighPatentConc$  is marginally insignificant ( $p = 0.11$ ). Overall, these results suggest that, after controlling for market power of affiliate  $i$ , we continue to find that patent concentration is associated with more tax-motivated income shifting. Thus, an affiliate's market power is unlikely to drive our baseline findings.

INSERT TABLE 11 HERE

### 5.3 Falsification Test: Asymmetric Information and Income Shifting via Debt

If *PatentConc* captures asymmetric information associated with patents rather than general characteristics on an MNC, we should not observe a relation between our measure and tax-motivated income shifting in a non-patent-related setting. To test this conjecture and to provide additional support for the validity of our measure, we examine tax-motivated income shifting via intra-firm debt. While interest payments on intra-firm debt allow MNCs to shift taxable income, the extent to which MNCs exploit this income-shifting channel should not vary with patent concentration. To this end, we replace the dependent variable with  $LN(I+FROA)$ , defined as

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<sup>27</sup> The univariate correlation between *PatentConc* and *MarketShare* is 0.19 ( $p < 0.01$ ).

<sup>28</sup> The slight loss in sample size in Table 11 is due to sales data being unavailable for some affiliates in our sample.

financial income of affiliate  $i$  in year  $t$  over total assets. This measure should capture income shifting via interest payments (Heckemeyer and Overesch 2017).

Table 12 presents the results. In column 1, we again replicate the income-shifting model by De Simone et al. (2017) for the full sample.<sup>29</sup> The coefficient on  $C$  is negative and significant ( $p < 0.01$ ), consistent with evidence for tax-motivated income shifting via debt. In columns 2 and 3, we interact  $C$  with *PatentConc* and *HighPatentConc* and estimate Equation (3) on the subsample of non-patent-holding affiliates. As expected, coefficients on  $C*PatentConc$  and  $C*HighPatentConc$  are insignificant in both columns (all  $p > 0.16$ ). These results indicate that tax-motivated income shifting via debt is not related to patent concentration, providing support that our measure indeed captures asymmetric information associated with patents.

INSERT TABLE 12 HERE

#### 5.4 *Asymmetric Information and Inbound Shifting to Patent-Holding Affiliates*

In our main tests, we focus on non-patent-holding affiliates because *PatentConc* captures the incentive to shift income *from* non-patent-holding affiliates *to* foreign affiliates that hold patents. Thus, while our results so far provide evidence for *outbound* income shifting via patents, asymmetric information could also be relevant for an MNC when choosing a particular patent-holding affiliate as a recipient for shifted income. Similar to the argument underlying our baseline hypothesis, we expect an MNC to have a greater incentive to shift income *to* an affiliate that holds a large fraction of patents compared to other MNCs operating in the same country-industry-year. Also in this case, the local tax authority assessing intra-firm royalty payments

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<sup>29</sup> We do not include  $C\_Patents$  in these tests because this variable captures income-shifting incentives induced by IP boxes, which do not apply to intra-firm interest payments. The sample in Table 12 is slightly larger because data on financial income is available for more affiliates than in our main sample.

from the non-patent-holding affiliate to the patent-holding affiliate lacks external comparable information. Thus, the sensitivity of a patent-holding affiliate's taxable income to income-shifting incentives should increase in the extent of asymmetric information.

To test this conjecture, we slightly modify our measure for patent concentration. That is, for patent-holding affiliate  $i$ , we calculate *PatentConcHold* as the number of patents held by all domestic affiliates of the MNC in year  $t$  divided by the sum of patents held by domestic affiliates of other MNCs operating in the same country-industry-year. Thus, in contrast to *PatentConc*, we focus on patents held in the country-industry-year of the patent-holding affiliate (rather than all patents held by the MNC) to isolate asymmetric information associated with a particular affiliate. We then re-run Equation (3) with this measure for the subsample of patent-holding affiliates. We expect negative coefficients on  $C*PatentConcHold$  and  $C\_Patents*PatentConcHold$ , consistent with tax-motivated income shifting increasing in the extent of asymmetric information.

Table 13 presents the results. As expected, the coefficients on  $C*PatentConcHold$  and  $C\_Patents*PatentConcHold$  are negative and significant in column 1 ( $p < 0.08$ ). These results suggest that the sensitivity of a patent-holding affiliate's taxable income to income-shifting incentives increases with asymmetric information. In column 2, we use an indicator variable with the value of one for patent-holding affiliates with patent concentration in the top sample quartile (*HighPatentConcHold*). Consistent with column 1, we find negative and significant coefficients on the interactions ( $p < 0.04$ ). Collectively, these results suggest that the level of asymmetric information is not only associated with outbound income shifting but also with the extent to which MNCs shift income via patents to a particular patent-holding affiliate.

INSERT TABLE 13 HERE

## 6. Conclusion

We examine whether and to what extent asymmetric information between the MNC and the local tax authority is associated with tax-motivated income shifting via patents. Using unconsolidated financial statement data and information on patent holdings, we show that tax-motivated income shifting increases in the share of patents held by an MNC relative to other MNCs operating in the same country-industry-year. These results indicate that high patent concentration, and thus a lack of comparable information for the local tax authority to assess an MNC's transfer-pricing strategy, facilitates tax-motivated income shifting via patents.

We also find that more external comparable information available to the local tax authority mitigates the observed relation between patent concentration and tax-motivated income shifting while more extensive transfer-pricing documentation requirements are less effective. Exploiting increases in actual tax enforcement, we show that the relation between asymmetric information and income shifting can be attributed to information asymmetry lowering the likelihood that local tax authorities might detect and successfully challenge an aggressive tax-position.

Our study contributes to research on the determinants of tax-motivated income shifting by showing that the level of comparable information is an important driver of the extent to which MNCs shift income via patents. Our findings also indicate that industry landscapes in which MNCs operate tend to determine the level of asymmetric information and thus shape the magnitude of income shifted. From a policy perspective, our findings suggest that the success of a tax-policy measure in curbing tax-motivated income shifting via patents critically depends on its ability to reduce information asymmetry by enlarging the set of comparable information or to credibly increase the likelihood of detecting and challenging aggressive tax-positions.

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## APPENDIX A: VARIABLE DEFINITIONS

### Dependent Variables

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$LN(EBIT)$	Natural logarithm of affiliate $i$ 's $EBIT$ in year $t$ .
$LN(PLBT)$	Natural logarithm of affiliate $i$ 's $PLBT$ in year $t$ .
$LN(1+FROA)$	Natural logarithm of 1 plus affiliate $i$ 's $FROA$ in year $t$ .
$LN(1+ROA)$	Natural logarithm of 1 plus affiliate $i$ 's $ROA$ in year $t$ .

### Income-Shifting Incentive Variables

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$C$	<p>Income-shifting incentive of affiliate <math>i</math> based on statutory corporate income tax rates and following Huizinga and Laeven (2008):</p> $C_{it} = \frac{1}{(1 - \tau_{it})} * \frac{\sum_{k \neq i}^n \frac{K_{kt}}{(1 - \tau_{kt})} * (\tau_{it} - \tau_{kt})}{\sum_{k \neq i}^n \frac{K_{k,t}}{(1 - \tau_{kt})}}$ <p><math>C</math> is calculated based on all tax-rate differentials between affiliate <math>i</math> and all other affiliates of the MNC in year <math>t</math>. We weight tax-rate differentials by total affiliate assets. Source: EY Corporate Tax Guides.</p>
$C\_Patents$	<p>Incremental income-shifting incentive induced by <i>preferential</i> tax rates on IP income. First, we re-calculate <math>C</math> using preferential tax rates on IP income for affiliate <math>i</math> in year <math>t</math>. Second, we calculate <math>C\_Patents</math> by subtracting <math>C</math> based on statutory corporate income tax rates from <math>C</math> based on preferential tax rates in IP income. Source: EY Corporate Tax Guides.</p>
$CTR$	<p>Statutory corporate income tax rate applicable in country <math>c</math> in year <math>t</math>. Source: EY Corporate Tax Guides.</p>
$CTR\_Patents$	<p>Preferential tax rate on IP income in country <math>c</math> in year <math>t</math> less <math>CTR</math> in year <math>t</math>. Source: EY Corporate Tax Guides.</p>

### Patent Concentration Measures

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$PatentConc$	<p>Patent concentration for affiliate <math>i</math> in year <math>t</math> calculated as the number of patents held by all affiliates of the MNC that holds affiliate <math>i</math> in year <math>t</math> divided by the sum of all patents held by MNCs with affiliates operating in the same country-industry-year as affiliate <math>i</math>. Industry is based on 2-digit NACE industry codes. Source: Orbis and PATSTAT.</p>
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<i>PatentConcHold</i>	Patent concentration for patent-holding affiliate <i>i</i> in year <i>t</i> calculated as the number of patents held by all domestic affiliates of the MNC in year <i>t</i> divided by the sum of patents held by domestic affiliates of other MNCs operating in the same country-industry-year.
<i>HighPatentConc</i>	Indicator variable with the value of one if <i>PatentConc</i> of affiliate <i>i</i> is in the top sample quartile, and zero otherwise.
<i>HighPatentConcHold</i>	Indicator variable with the value of one if <i>PatentConcHold</i> of affiliate <i>i</i> is in the top sample quartile of patent-holding affiliates, and zero otherwise.
<i>PatentQualityConc</i>	Patent concentration for affiliate <i>i</i> in year <i>t</i> based on the number of patent citations on the patents held by all affiliates of the MNC that holds affiliate <i>i</i> in year <i>t</i> divided by the number of patent citations on all patents held by MNCs with affiliates operating in the same country-industry-year as affiliate <i>i</i> . Industry is based on 2-digit NACE industry codes. Source: Orbis and PATSTAT.

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#### **Patent Measures**

<i>PatStock</i>	Number of granted patents held by affiliate <i>i</i> in year <i>t</i> . We combine all worldwide patents that were granted in the last 19 years preceding year <i>t</i> . Source: PATSTAT.
<i>SumPatents</i>	Number of patents held by all affiliates of the MNC that holds affiliate <i>i</i> in year <i>t</i> . Source: Orbis and PATSTAT.

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#### **Independent Variables**

<i>LN(TangibleAssets)</i>	Natural logarithm of affiliate <i>i</i> 's <i>TangibleAssets</i> in year <i>t</i> .
<i>Tangible Assets</i>	Total fixed assets of affiliate <i>i</i> in year <i>t</i> . Source: Orbis.
<i>LN(CompExpense)</i>	Natural logarithm of affiliate <i>i</i> 's <i>CompExpense</i> in year <i>t</i> .
<i>CompExpense</i>	Compensation expense of affiliate <i>i</i> in year <i>t</i> . Source: Orbis.
<i>IndustryROA</i>	Country-industry-year median <i>ROA</i> for all companies in Orbis. Industry is based on 2-digit NACE industry codes. Source: Orbis
<i>LN(Age)</i>	Natural logarithm of <i>Age</i> .
<i>Age</i>	Year <i>t</i> less the first year in which affiliate <i>i</i> appears in the Orbis database. Source: Orbis.

<i>GDPGrowth</i>	Annual change in GDP from year $t-1$ to year $t$ in affiliate country $c$ . Source: World Bank national accounts data.
<i>ΔMarketSize</i>	Annual percentage change in total sales of all affiliates and independent firms by country-industry-year. Industry is based on 2-digit NACE industry codes. Source: Orbis.
<i>Loss</i>	Indicator variable with the value of one if <i>EBIT</i> of affiliate $i$ is less than zero, and zero otherwise.
<i>MarketShare</i>	Total sales of affiliate $i$ in year $t$ and divided by total sales of all firms in the same country-industry-year. Source: Orbis.
<b>Other Variables</b>	
<i>ROA</i>	<i>EBIT</i> of affiliate $i$ in year $t$ scaled by total assets of affiliate $i$ in year $t$ . Source: Orbis.
<i>EBIT</i>	Earnings before interest and taxes of affiliate $i$ in year $t$ . Source: Orbis.
<i>PLBT</i>	Pre-tax profit of affiliate $i$ in year $t$ . Source: Orbis.
<i>FROA</i>	Financial income of affiliate $i$ in year $t$ scaled by total assets of affiliate $i$ in year $t$ . Source: Orbis.
<i>Sales</i>	Sales of affiliate $i$ in year $t$ . Source: Orbis.
<i>Size</i>	Natural logarithm of total assets of affiliate $i$ in year $t$ . Source: Orbis.
<i>Total Assets</i>	Total assets of affiliate $i$ in year $t$ . Source: Orbis.
<b>Partitioning Variables</b>	
<i>HighPatAffiliates</i>	Indicator variable with the value of one if the ratio of patent-holding affiliates of MNCs to all affiliates of MNCs in a country-industry-year is in the top sample quartile. Industry is based on 2-digit NACE industry codes. Source: Orbis and PATSTAT.
<i>TPDocu</i>	Indicator variable with the value of one if country $c$ adopted a transfer-pricing documentation requirement in years $t$ or $t-1$ and zero if no change in transfer-pricing documentation requirement occurred in years $t$ and $t-1$ . Source: Lohse and Riedel (2013), Beer and Loeprick (2015), EY Worldwide Transfer Pricing Guides.

### *Enforcement*

First, indicator variable with the value of one if country  $c$  experienced an increase in the value of completed tax assessments over total net revenue collections in the previous year (i.e. from year  $t-2$  to  $t-1$ ), and zero otherwise. Second, indicator variable with the value of one if country  $c$  experienced an increase in the percentage of staff used for tax audit and verification in the previous year. Third, indicator variable with the value of one if country  $c$  experienced an increase in overall tax administration expenditure scaled by GDP in the previous year. Source: OECD (2010, 2013, 2015, 2017).

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## APPENDIX B: NUMERICAL EXAMPLE FOR *PATENTCONC*

Figure 1 illustrates our approach to measure *PatentConc* as a proxy for the level of asymmetric information between an MNC and the local tax authority over how to value royalty payments. In this section, we provide a numerical example for how to calculate *PatentConc* for the German affiliate of MNC 1 (hereafter, affiliate *i*) in Figure 1. We assume that German affiliates of the other MNCs displayed in Figure 1 (i.e. MNCs 2-4 in panel A and MNC 2 in panel B) operate in the same 2-digit NACE industry as affiliate *i*.

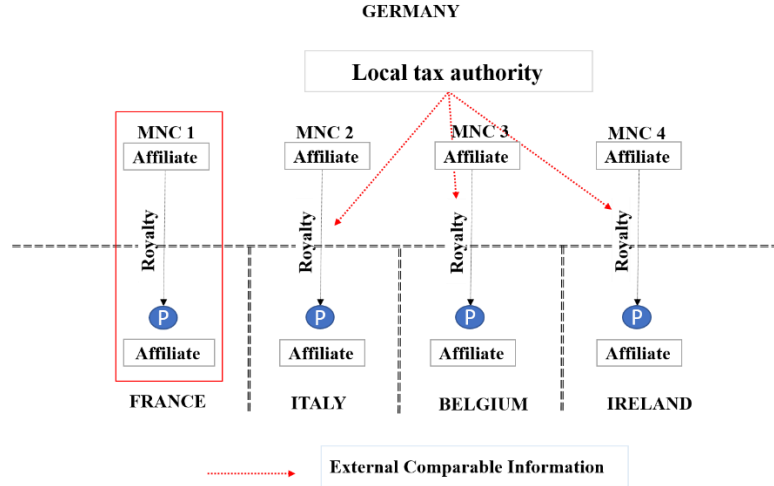
We calculate *PatentConc* for affiliate *i* as the sum of patents held by all domestic and foreign affiliates of MNC 1 divided by the sum of patents held by all domestic and foreign affiliates of MNCs with affiliates operating in the same country-industry-year (CIY) as affiliate *i*, including the number of patents held by MNC 1. Thereby, we obtain the share of patents owned by MNC 1 relative to other MNCs with affiliates operating in the same CIY as affiliate *i*. In both panels of Figure 1, the sum of patents held by MNCs with affiliates operating in the same CIY as affiliate *i* is equal to four. In the case of low information asymmetry (panel A), MNC 1 holds one patent. As a result, *PatentConc* of affiliate *i* is equal to 0.25 ( $= 1 / (1+3)$ ). In the case of high information asymmetry (panel B), MNC 1 holds three patents. As a result, *PatentConc* of affiliate *i* is equal to 0.75 ( $= 3 / (3+1)$ ). By calculating the share of patents held by affiliates of an MNC relative to MNCs with affiliates operating in the same CIY, *PatentConc* is constrained between zero and one. We summarize this example in the table below.

Information Asymmetry	Low	High
$\Sigma$ of Patents MNC 1	1	3
$\Sigma$ of Patents other MNCs in same CIY	3	1
$\Sigma$ (Patents in CIY)	4	4
$PatentConc = \Sigma \text{ of Patents MNC 1} / \Sigma \text{ of Patents in same CIY}$	0.25	0.75

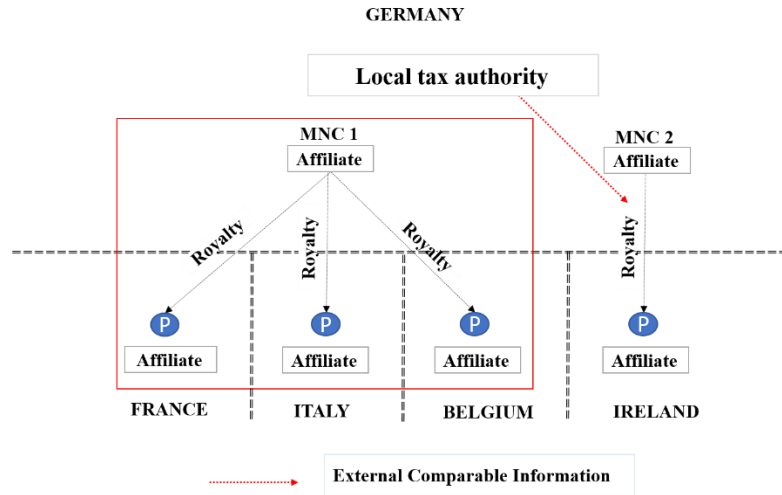
## FIGURES AND TABLES

Figure 1: Measuring Information Asymmetry

### Panel A: Low Information Asymmetry

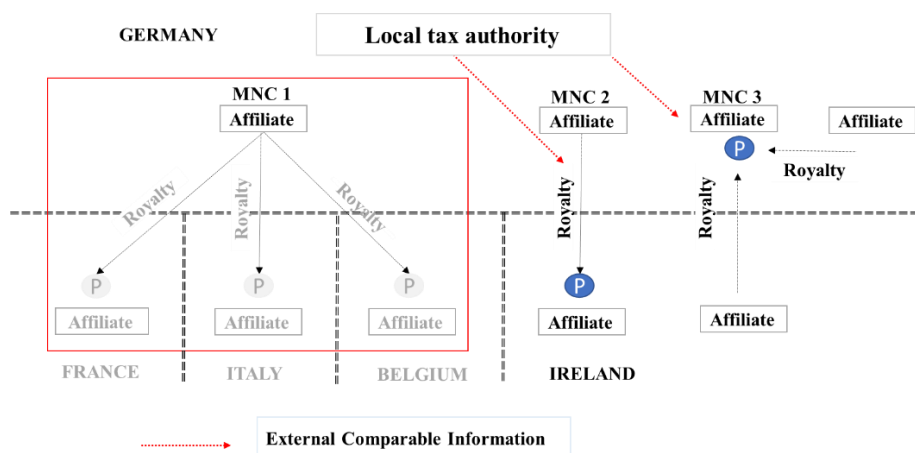


### Panel B: High Information Asymmetry



**Note:** This figure illustrates our approach to measure patent concentration (*PatentConc*) as our proxy for the level of asymmetric information between the MNC and the local tax authority. Assume that the local tax authority requires external comparable information to assess the arm's length price set by MNC 1 on cross-border royalty payments between its affiliates. In panel A, patent concentration is low because patents are distributed across several MNCs with affiliates operating in the same country-industry-year as MNC 1. The local tax authority has access to a large set of external comparable information from other affiliates of MNCs to assess the arm's length price. This leads to low information asymmetry over how to value royalty payments of MNC 1. In panel B, patent concentration is high because patents are concentrated in MNC 1 relative to other MNCs with affiliates operating in the same country-industry year. The local tax authority lacks external comparable information from other affiliates of MNCs to assess the arm's length price. This leads to high information asymmetry over how to value royalty payments of MNC 1.

**Figure 2: External Comparable Information**



**Note:** This figure illustrates our approach to capture external comparable information available to the local tax authority when assessing the arm's length price set by MNC1 on cross-border royalty payments between its affiliates. In addition to cross-border royalty payments (i.e., MNC2), the local tax authority could also compare the profit margins of foreign affiliates to those of local patent-holding affiliates of other MNCs (i.e., MNC3). This might reduce information asymmetry over how to value royalty payments with respect to MNC 1.

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**Table 1: Sample Selection**

<b>Sample Selection</b>	<b>Affiliate-Years</b>
European affiliate-years in Bureau van Dijk's Orbis database with at least one foreign affiliate located in another European country, non-missing NACE industry codes, and positive values for total assets, tangible fixed assets and compensation expense (sample period: 2008-2016)	163,865
<i>Less:</i> Affiliates of MNCs operating in the banking or the insurance industry (2-digit NACE codes: 64, 65, and 66)	(2,148)
<i>Less:</i> Affiliate-years of MNCs with negative return on sales	(20,873)
<i>Less:</i> Affiliate-years with missing values for <i>EBIT</i> and with values for $LN(I+ROA)$ less than or equal to zero	(566)
<i>Less:</i> Affiliate-years with missing data for computing independent variables	(1,985)
<b>Final Sample</b>	<b>138,293</b>

**Note:** This table shows the sample selection. We obtain unconsolidated financial statement data for foreign affiliates from Bureau van Dijk's Orbis database.



**Table 2: Sample Composition by Country**

<b>Country</b>	<b>Affiliate-Years</b>	<b>Mean Corporate Tax Rate</b>	<b>Mean IP Tax Rate</b>
Austria	2,602	0.25	0.25
Belgium	10,963	0.34	0.07
Bulgaria	708	0.10	0.10
Czech Republic	6,218	0.19	0.19
Denmark	104	0.24	0.24
Estonia	1,350	0.21	0.21
Finland	4,776	0.23	0.23
France	19,254	0.33	0.16
Germany	12,118	0.30	0.30
Hungary	2,452	0.19	0.09
Iceland	41	0.19	0.19
Ireland	3	0.13	0.10
Italy	18,278	0.31	0.29
Latvia	52	0.15	0.15
Luxembourg	745	0.29	0.06
Malta	32	0.35	0.12
Netherlands	540	0.25	0.06
Norway	5,870	0.27	0.27
Poland	5,721	0.19	0.19
Portugal	6,788	0.24	0.20
Romania	4,228	0.16	0.16
Slovakia	3,463	0.21	0.21
Slovenia	1,356	0.18	0.18
Spain	18,019	0.29	0.14
Sweden	10,197	0.24	0.24
Switzerland	41	0.18	0.12
United Kingdom	849	0.24	0.18
<b>All Countries</b>	<b>138,293</b>	<b>0.23</b>	<b>0.17</b>

**Note:** This table presents the sample composition by country. The sample includes 138,293 affiliate-year observations over the sample period 2008-2016. Column 1 presents the number of affiliate-years. Column 2 presents the average statutory corporate income tax rate and column 3 the average IP tax rate.

**Table 3: Descriptive Statistics**

<b>Panel A: Full Sample</b>						
<b>Variables</b>	<b>N</b>	<b>Mean</b>	<b>P25</b>	<b>Median</b>	<b>P75</b>	<b>SD</b>
<i>EBIT</i>	138,293	3,082,883	55,000	395,000	1,564,000	42,753,300
<i>ROA</i>	138,293	0.075	0.014	0.057	0.131	0.135
<i>LN(1+ROA)</i>	138,293	0.065	0.014	0.055	0.123	0.128
<i>TangibleAssets</i>	138,293	7,045,321	103,000	740,000	4,056,000	20,896,530
<i>CompExpense</i>	138,293	5,860,280	626,000	1,804,000	4,993,000	12,607,610
<i>LN(TangibleAssets)</i>	138,293	6.434	4.635	6.607	8.308	2.561
<i>LN(CompExpense)</i>	138,293	7.461	6.439	7.498	8.516	1.628
<i>IndustryROA</i>	138,293	0.038	0.020	0.037	0.055	0.026
<i>LN(Age)</i>	138,293	1.430	1.099	1.609	1.946	0.653
<i>GDPGrowth</i>	138,293	-0.008	-0.078	0.011	0.046	0.083
<i>ΔMarketSize</i>	138,293	0.012	-0.066	0.009	0.073	0.123
<i>Loss</i>	138,293	0.171	0.000	0.000	0.000	0.376
<i>C</i>	138,293	-0.008	-0.008	0.001	0.010	0.050
<i>C_Patents</i>	138,293	-0.004	-0.019	0.000	0.012	0.074
<i>PatentConc</i>	138,293	0.048	0.000	0.000	0.004	0.168
<i>PatStock</i>	138,293	2.849	0.000	0.000	0.000	40.035
<i>SumPatents</i>	138,293	35.622	0.000	0.000	5.000	230.668

**Panel B: Patent-Holding Affiliates (*PatStock* > 0)**

<b>Variables</b>	<b>N</b>	<b>Mean</b>	<b>P25</b>	<b>Median</b>	<b>P75</b>	<b>SD</b>
<i>EBIT</i>	14,412	10,682,310	455,500	1,913,000	6,103,000	77,282,440
<i>ROA</i>	14,412	0.076	0.023	0.059	0.119	0.102
<i>LN(1+ROA)</i>	14,412	0.068	0.022	0.057	0.112	0.096
<i>TangibleAssets</i>	14,412	17,919,270	1,250,000	5,453,500	16,493,000	33,040,140
<i>CompExpense</i>	14,412	16,401,390	3,044,000	7,639,000	19,524,000	21,687,950
<i>LN(TangibleAssets)</i>	14,412	8.319	7.131	8.604	9.711	2.074
<i>LN(CompExpense)</i>	14,412	8.908	8.021	8.941	9.879	1.380
<i>IndustryROA</i>	14,412	0.047	0.030	0.043	0.066	0.026
<i>LN(Age)</i>	14,412	1.498	1.099	1.609	1.946	0.626
<i>GDPGrowth</i>	14,412	-0.009	-0.083	0.011	0.046	0.079
<i>ΔMarketSize</i>	14,412	0.008	-0.072	0.006	0.073	0.123
<i>Loss</i>	14,412	0.112	0.000	0.000	0.000	0.316
<i>C</i>	14,412	0.005	-0.001	0.002	0.011	0.028
<i>C_Patents</i>	14,412	0.008	-0.004	0.001	0.016	0.060
<i>PatentConc</i>	14,412	0.095	0.002	0.012	0.070	0.208
<i>PatStock</i>	14,412	27.341	2.000	5.000	16.000	121.289
<i>SumPatents</i>	14,412	69.727	3.000	10.000	40.000	259.430

**Panel C: Non-Patent-Holding Affiliates (*PatStock* = 0)**

<b>Variables</b>	<b>N</b>	<b>Mean</b>	<b>P25</b>	<b>Median</b>	<b>P75</b>	<b>SD</b>
<i>EBIT</i>	123,881	2,198,785***	45,000	333,000***	1,275,000	36,581,430
<i>ROA</i>	123,881	0.075	0.013	0.056***	0.132	0.138
<i>LN(1+ROA)</i>	123,881	0.064***	0.013	0.055***	0.124	0.132
<i>TangibleAssets</i>	123,881	5,780,274***	85,000	586,000***	3,096,000	18,577,340
<i>CompExpense</i>	123,881	4,633,954***	558,000	1,541,000***	4,054,000	10,406,500
<i>LN(TangibleAssets)</i>	123,881	6.215***	4.443	6.373***	8.038	2.521
<i>LN(CompExpense)</i>	123,881	7.293***	6.324	7.340***	8.307	1.571
<i>IndustryROA</i>	123,881	0.037***	0.018	0.036***	0.054	0.026
<i>LN(Age)</i>	123,881	1.422***	1.099	1.609***	1.946	0.656
<i>GDPGrowth</i>	123,881	-0.008	-0.078	0.011	0.046	0.083
<i>ΔMarketSize</i>	123,881	0.013***	-0.065	0.010***	0.073	0.123
<i>Loss</i>	123,881	0.178***	0.000	0.000***	0.000	0.382
<i>C</i>	123,881	-0.010***	-0.011	0.000***	0.010	0.051
<i>C_Patents</i>	123,881	-0.005***	-0.022	0.000***	0.012	0.076
<i>PatentConc</i>	123,881	0.042***	0.000	0.000***	0.002	0.162
<i>PatStock</i>	123,881	0.000***	0.000	0.000***	0.000	0.000
<i>SumPatents</i>	123,881	31.654***	0.000	0.000***	3.000	226.754

**Note:** This table presents descriptive statistics. Panel A presents descriptive statistics for the full sample of 138,293 affiliate-year observations over the sample period 2008-2016. Panel B presents descriptive statistics for patent-holding affiliates (14,412 affiliate-year observations) and panel C for non-patent-holding affiliates (123,811 affiliate-year observations). We conduct a two-sample t-test (Wilcoxon rank-sum test) to compare means (medians) between panels B and C. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

**Table 4: Correlation Table**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) $LN(1+ROA)$	1.000										
(2) $LN(TangibleAssets)$	<b>-0.061</b>	1.000									
(3) $LN(CompExpense)$	<b>0.037</b>	<b>0.588</b>	1.000								
(4) $IndustryROA$	<b>0.111</b>	<b>0.014</b>	<b>0.195</b>	1.000							
(5) $LN(Age)$	0.001	<b>0.029</b>	<b>0.077</b>	<b>-0.127</b>	1.000						
(6) $GDPGrowth$	<b>0.026</b>	0.004	0.006	<b>0.118</b>	<b>-0.224</b>	1.000					
(7) $\Delta MarketSize$	<b>0.039</b>	0.004	<b>-0.008</b>	<b>0.135</b>	<b>-0.434</b>	<b>0.381</b>	1.000				
(8) $Loss$	<b>-0.622</b>	<b>-0.050</b>	<b>-0.098</b>	<b>-0.077</b>	<b>-0.037</b>	<b>-0.013</b>	<b>-0.014</b>	1.000			
(9) $C$	<b>-0.031</b>	<b>0.020</b>	<b>0.176</b>	<b>0.071</b>	<b>0.034</b>	<b>-0.040</b>	<b>-0.060</b>	<b>-0.014</b>	1.000		
(10) $C\_Patents$	<b>0.007</b>	<b>0.010</b>	<b>0.056</b>	<b>0.060</b>	<b>0.012</b>	<b>-0.013</b>	<b>-0.027</b>	<b>-0.015</b>	<b>0.132</b>	1.000	
(11) $PatentConc$	<b>-0.018</b>	<b>0.090</b>	<b>0.072</b>	<b>-0.035</b>	<b>-0.033</b>	<b>0.017</b>	<b>0.026</b>	<b>0.034</b>	<b>-0.135</b>	<b>-0.053</b>	1.000

**Note:** This table presents univariate Pearson correlation coefficients. Bold coefficients denote significance at the 1% level.

**Table 5: Extension of the De Simone et al. (2017) Income-Shifting Model**

Dependent Variable	$LN(I+ROA)$ (1)	$LN(I+ROA)$ (2)	$LN(I+ROA)$ (3)
$LN(TangibleAssets)$	-0.005*** (0.000)	-0.005*** (0.000)	-0.005*** (0.000)
$LN(CompExpense)$	0.003*** (0.000)	0.003*** (0.000)	0.003*** (0.000)
$IndustryROA$	0.217*** (0.033)	0.218*** (0.033)	0.218*** (0.033)
$LN(Age)$	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)
$GDPGrowth$	0.022** (0.010)	0.022** (0.010)	0.022** (0.010)
$\Delta MarketSize$	0.005 (0.003)	0.005 (0.003)	0.005 (0.003)
$C$	-0.097*** (0.014)	-0.105*** (0.015)	-0.101*** (0.016)
$C\_Patents$		-0.009 (0.007)	-0.003 (0.008)
$Loss$	-0.208*** (0.002)	-0.208*** (0.002)	-0.208*** (0.002)
$C*Loss$	0.289*** (0.027)	0.289*** (0.027)	0.269*** (0.031)
$C\_Patents*Loss$			-0.026 (0.019)
Country-FE	Y	Y	Y
Industry-FE	Y	Y	Y
Year-FE	Y	Y	Y
N	138,293	138,293	138,293
Adjusted R <sup>2</sup>	0.419	0.419	0.419

**Note:** This table presents regression results for extending the income-shifting model by DeSimone, Klassen, and Seidman (2017) on the full sample of 138,293 affiliate-year observations. The dependent variable is  $LN(I+ROA)$ .  $ROA$  is defined as earnings before interest and taxes of affiliate  $i$  divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

**Table 6: Patent Concentration and Income Shifting**

Dependent Variable	$LN(I+ROA)$ (1)	$LN(I+ROA)$ (2)
<i>C</i>	-0.087*** (0.016)	-0.084*** (0.017)
<i>C_Patents</i>	0.002 (0.009)	0.003 (0.009)
<i>Loss</i>	-0.211*** (0.002)	-0.211*** (0.002)
<i>C*Loss</i>	0.253*** (0.032)	0.252*** (0.032)
<i>C_Patents*Loss</i>	-0.030 (0.020)	-0.030 (0.020)
<i>PatentConc</i>	-0.010** (0.004)	
<i>C*PatentConc</i>	-0.144*** (0.050)	
<i>C_Patents*PatentConc</i>	-0.064** (0.031)	
<i>HighPatentConc</i>		-0.002 (0.002)
<i>C*HighPatentConc</i>		-0.071** (0.032)
<i>C_Patents*HighPatentConc</i>		-0.035* (0.020)
Additional Controls	Y	Y
Country-FE	Y	Y
Industry-FE	Y	Y
Year-FE	Y	Y
N	123,881	123,881
Adjusted R <sup>2</sup>	0.425	0.425

**Note:** This table presents regression results for the relation between patent concentration and tax-motivated income shifting via patents. All columns include the subsample of non-patent-holding affiliates (123,811 affiliate-year observations). The dependent variable is  $LN(I+ROA)$ .  $ROA$  is defined as earnings before interest and taxes of affiliate  $i$  divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

**Table 7: High External Comparable Information**

Dependent Variable	$LN(I+ROA)$ (1)	$LN(I+ROA)$ (2)
<i>C</i>	-0.087*** (0.018)	-0.082*** (0.018)
<i>C_Patents</i>	0.002 (0.010)	0.003 (0.010)
<i>Loss</i>	-0.211*** (0.002)	-0.211*** (0.002)
<i>C*Loss</i>	0.252*** (0.032)	0.251*** (0.032)
<i>C_Patents*Loss</i>	-0.030 (0.020)	-0.030 (0.020)
<i>C*PatentConc</i>	-0.173*** (0.055)	
<i>C_Patents*PatentConc</i>	-0.079** (0.035)	
<i>C*PatentConc*HighPatAffiliates</i>	0.154 (0.135)	
<i>C_Patents*PatentConc*HighPatAffiliates</i>	0.076 (0.079)	
<i>C*HighPatentConc</i>		-0.114*** (0.037)
<i>C_Patents*HighPatentConc</i>		-0.058** (0.025)
<i>C*HighPatentConc*HighPatAffiliates</i>		0.170** (0.073)
<i>C_Patents*HighPatentConc*HighPatAffiliates</i>		0.092** (0.043)
Additional Controls	Y	Y
Country-FE	Y	Y
Industry-FE	Y	Y
Year-FE	Y	Y
N	123,881	123,881
Adjusted R <sup>2</sup>	0.425	0.425

**Note:** This table presents regression results for the moderating effect of high external comparable information on tax-motivated income shifting via patents. All columns include the subsample of non-patent-holding affiliates (123,811 affiliate-year observations). The dependent variable is  $LN(I+ROA)$ .  $ROA$  is defined as earnings before interest and taxes of affiliate  $i$  divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

**Table 8: Adoption of Transfer-Pricing Documentation Requirements**

Dependent Variable	$LN(I+ROA)$ (1)	$LN(I+ROA)$ (2)	$LN(I+ROA)$ (3)
<i>C</i>	-0.097*** (0.016)	-0.089*** (0.017)	-0.086*** (0.017)
<i>C_Patents</i>	-0.002 (0.009)	0.002 (0.009)	0.003 (0.009)
<i>Loss</i>	-0.211*** (0.002)	-0.211*** (0.002)	-0.211*** (0.002)
<i>C*Loss</i>	0.251*** (0.032)	0.253*** (0.032)	0.252*** (0.032)
<i>C_Patents*Loss</i>	-0.030 (0.020)	-0.030 (0.020)	-0.030 (0.020)
<i>C*PatentConc</i>		-0.160*** (0.051)	
<i>C_Patents*PatentConc</i>		-0.067** (0.032)	
<i>C*TPDocu</i>	0.057* (0.032)	0.038 (0.035)	0.041 (0.036)
<i>C_Patents*TPDocu</i>	0.008 (0.014)	0.004 (0.015)	0.002 (0.016)
<i>C*PatentConc*TPDocu</i>		0.223** (0.113)	
<i>C_Patents*PatentConc*TPDocu</i>		0.036 (0.071)	
<i>C*HighPatentConc</i>			-0.080** (0.032)
<i>C_Patents*HighPatentConc</i>			-0.039* (0.021)
<i>C*HighPatentConc*TPDocu</i>			0.120 (0.082)
<i>C_Patents*HighPatentConc*TPDocu</i>			0.053 (0.042)
Additional Controls	Y	Y	Y
Country-FE	Y	Y	Y
Industry-FE	Y	Y	Y
Year-FE	Y	Y	Y
N	123,881	123,881	123,881
Adjusted R <sup>2</sup>	0.425	0.425	0.425

**Note:** This table presents regression results for the moderating effect of the adoption of transfer-pricing documentation requirements on tax-motivated income shifting via patents. All columns include non-patent-holding affiliates. The dependent variable is  $LN(I+ROA)$ .  $ROA$  is defined as earnings before interest and taxes of affiliate  $i$  divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed)



**Table 9: Increase in Tax Enforcement**

Dependent Variable	$LN(1+ROA)$ (1)	$LN(1+ROA)$ (2)	$LN(1+ROA)$ (3)	$LN(1+ROA)$ (4)	$LN(1+ROA)$ (5)	$LN(1+ROA)$ (6)
<i>Enforcement</i>	<i>Completed Tax Assessments</i>		<i>Staff Usage for Verification</i>		<i>Tax Administration Expenditure</i>	
<i>C</i>	-0.064** (0.025)	-0.059** (0.025)	-0.082*** (0.028)	-0.081*** (0.028)	-0.082*** (0.020)	-0.081*** (0.020)
<i>C_Patents</i>	0.026** (0.013)	0.025** (0.013)	0.013 (0.017)	0.017 (0.017)	0.005 (0.010)	0.005 (0.010)
<i>Loss</i>	-0.195*** (0.003)	-0.195*** (0.003)	-0.197*** (0.003)	-0.197*** (0.003)	-0.205*** (0.002)	-0.205*** (0.002)
<i>C*Loss</i>	0.198*** (0.043)	0.197*** (0.043)	0.237*** (0.057)	0.235*** (0.057)	0.255*** (0.037)	0.254*** (0.037)
<i>C_Patents*Loss</i>	-0.038 (0.029)	-0.039 (0.029)	-0.000 (0.034)	0.000 (0.034)	-0.043* (0.023)	-0.042* (0.023)
<i>C*PatentConc</i>	-0.195** (0.080)		-0.285*** (0.104)		-0.164** (0.068)	
<i>C_Patents*PatentConc</i>	-0.070 (0.047)		-0.213*** (0.070)		-0.076* (0.040)	
<i>C*Enforcement</i>	0.002 (0.022)	0.007 (0.023)	-0.014 (0.030)	-0.018 (0.030)	-0.009 (0.019)	-0.011 (0.020)
<i>C_Patents*Enforcement</i>	0.002 (0.012)	-0.004 (0.012)	-0.016 (0.018)	-0.021 (0.018)	0.000 (0.011)	0.003 (0.011)
<i>C*PatentConc*Enforcement</i>	0.191** (0.092)		0.203 (0.152)		0.004 (0.082)	
<i>C_Patents*PatentConc*Enforcement</i>	0.162*** (0.055)		0.163 (0.104)		0.070 (0.048)	
<i>C*HighPatentConc</i>		-0.099** (0.047)		-0.123* (0.063)		-0.080** (0.039)
<i>C_Patents*HighPatentConc</i>		-0.022 (0.033)		-0.135*** (0.041)		-0.033 (0.024)
<i>C*HighPatentConc*Enforcement</i>		0.060 (0.052)		0.104 (0.080)		0.049 (0.049)
<i>C_Patents*HighPatentConc*Enforcemen</i>		0.132*** (0.035)		0.115** (0.053)		0.021 (0.031)

Additional Controls	Y	Y	Y	Y	Y	Y
Country-FE	Y	Y	Y	Y	Y	Y
Industry-FE	Y	Y	Y	Y	Y	Y
Year-FE	Y	Y	Y	Y	Y	Y
N	41,632	41,632	22,409	22,409	78,937	78,937
Adjusted R <sup>2</sup>	0.422	0.422	0.409	0.409	0.423	0.423

**Note:** This table presents regression results for the moderating effect of an increase in tax enforcement on tax-motivated income shifting via patents. In columns 1 and 2 (3 and 4) [5 and 6], *Enforcement* is an indicator variable with the value of one if country *c* experienced an increase in the value of completed tax assessments (staff usage for verification) [overall tax administration expenditure]. The dependent variable is  $LN(1+ROA)$ . *ROA* is defined as earnings before interest and taxes of affiliate *i* divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

**Table 10: Robustness Tests**

Dependent Variable	$LN(I+ROA)$ (1)	$LN(I+ROA)$ (2)	$LN(EBIT)$ (3)	$LN(PLBT)$ (4)
<i>C</i>	-0.085*** (0.016)		0.100 (0.229)	-0.197 (0.262)
<i>C_Patents</i>	0.002 (0.009)		0.188 (0.123)	0.232* (0.138)
<i>CTR</i>		-0.114*** (0.032)		
<i>Loss</i>	-0.211*** (0.002)	-0.316*** (0.008)		
<i>C*Loss</i>	0.252*** (0.032)			
<i>C_Patents*Loss</i>	-0.030 (0.020)			
<i>CTT*Loss</i>		0.038*** (0.013)		
<i>PatentQualityConc</i>	-0.008* (0.004)			
<i>C*PatentQualityConc</i>	-0.152*** (0.051)			
<i>C_Patents*PatentQualityCo</i>	-0.072** (0.032)			
<i>PatentConc</i>		0.038*** (0.013)	0.028 (0.066)	0.135* (0.072)
<i>CTR*PatentConc</i>		-0.167*** (0.052)		
<i>C*PatentConc</i>			-2.230*** (0.829)	-2.294** (0.900)
<i>C_Patents*PatentConc</i>			-0.781 (0.530)	-1.444** (0.587)
Additional Controls	Y	Y	Y	Y
Country-FE	Y	Y	Y	Y
Industry-FE	Y	Y	Y	Y
Year-FE	Y	Y	Y	Y
N	123,881	123,881	101,654	99,380
Adjusted R <sup>2</sup>	0.425	0.426	0.486	0.440

**Note:** This table presents regression results for robustness tests. In columns 1 and 2, the dependent variable is  $LN(I+ROA)$ .  $ROA$  is defined as earnings before interest and taxes of affiliate  $i$  divided by total assets. In column 3, the dependent variable is  $LN(EBIT)$ . In column 4, the dependent variable is  $LN(PLBT)$ . All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

**Table 11: Controlling for Market Power**

Dependent Variable	$LN(I+ROA)$ (1)	$LN(I+ROA)$ (2)
<i>C</i>	-0.081*** (0.017)	-0.078*** (0.017)
<i>C_Patents</i>	0.005 (0.009)	0.006 (0.009)
<i>Loss</i>	-0.212*** (0.002)	-0.212*** (0.002)
<i>C*Loss</i>	0.245*** (0.032)	0.244*** (0.032)
<i>C_Patents*Loss</i>	-0.035* (0.020)	-0.035* (0.020)
<i>PatentConc</i>	-0.009** (0.004)	
<i>C*PatentConc</i>	-0.122** (0.051)	
<i>C_Patents*PatentConc</i>	-0.058* (0.032)	
<i>MarketShare</i>	0.013 (0.027)	0.013 (0.027)
<i>C*MarketShare</i>	-0.774 (0.511)	-0.760 (0.511)
<i>C_Patents*MarketShare</i>	-0.441 (0.321)	-0.457 (0.325)
<i>HighPatentConc</i>		-0.002 (0.002)
<i>C*HighPatentConc</i>		-0.067** (0.033)
<i>C_Patents*HighPatentConc</i>		-0.034 (0.021)
Additional Controls	Y	Y
Country-FE	Y	Y
Industry-FE	Y	Y
Year-FE	Y	Y
N	118,805	118,805
Adjusted R <sup>2</sup>	0.426	0.426

**Note:** This table presents regression results for tests that control for market power. The dependent variable is  $LN(I+ROA)$ . *ROA* is defined as earnings before interest and taxes of affiliate *i* divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

**Table 12: Patent Concentration and Income Shifting via Debt**

Dependent Variable	$LN(I+FROA)$ (1)	$LN(I+FROA)$ (2)	$LN(I+FROA)$ (3)
<i>C</i>	-0.014*** (0.004)	-0.017*** (0.005)	-0.017*** (0.005)
<i>Loss</i>	-0.032*** (0.000)	-0.032*** (0.000)	-0.032*** (0.000)
<i>C*Loss</i>	0.034*** (0.005)	0.039*** (0.005)	0.039*** (0.005)
<i>PatentConc</i>		-0.001 (0.001)	
<i>C*PatentConc</i>		-0.013 (0.010)	
<i>HighPatentConc</i>			-0.001 (0.000)
<i>C*HighPatentConc</i>			-0.008 (0.006)
Additional Controls	Y	Y	Y
Country-FE	Y	Y	Y
Industry-FE	Y	Y	Y
Year-FE	Y	Y	Y
N	138,595	124,169	124,169
Adjusted R <sup>2</sup>	0.353	0.347	0.347

**Note:** This table presents regression results for falsification tests examining the relation between patent concentration and income shifting via debt. Column 1 presents results for the replication of the income-shifting model by DeSimone, Klassen, and Seidman (2017) based on the full sample (138,595 affiliate-year observations). Columns 2 and 3 present results for the relation between patent concentration and debt shifting based on the subsample of non-patent-holding affiliates (124,169 affiliate-year observations). The dependent variable is  $LN(I+FROA)$ . *FROA* is defined as financial income of affiliate *i* divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. \*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% level, respectively.

**Table 13: Patent Concentration and Patent-Holding Affiliates**

Dependent Variable	LN(1+ROA) (1)	LN(1+ROA) (2)
<i>C</i>	-0.002 (0.072)	-0.042 (0.069)
<i>C_Patents</i>	0.012 (0.026)	0.008 (0.025)
<i>Loss</i>	-0.166*** (0.005)	-0.166*** (0.005)
<i>C*Loss</i>	0.212 (0.155)	0.207 (0.155)
<i>C_Patents*Loss</i>	-0.017 (0.052)	-0.017 (0.052)
<i>PatentConcHold</i>	-0.004 (0.006)	
<i>C*PatentConcHold</i>	-0.622*** (0.175)	
<i>C_Patents*PatentConcHold</i>	-0.133* (0.077)	
<i>HighPatentConcHold</i>		-0.002 (0.004)
<i>C*HighPatentConcHold</i>		-0.459*** (0.147)
<i>C_Patents*HighPatentConcHold</i>		-0.118** (0.057)
Additional Controls	Y	Y
Country-FE	Y	Y
Industry-FE	Y	Y
Year-FE	Y	Y
N	14,411	14,411
Adjusted R <sup>2</sup>	0.383	0.382

**Note:** This table presents regression results for the relation between patent concentration and tax-motivated income shifting via patents. All columns include the subsample of patent-holding affiliates (14,412 affiliate-year observations). The dependent variable is  $LN(1+ROA)$ .  $ROA$  is defined as earnings before interest and taxes of affiliate  $i$  divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).